NATIONAL PETROLEUM NEWS

June 5, 1946

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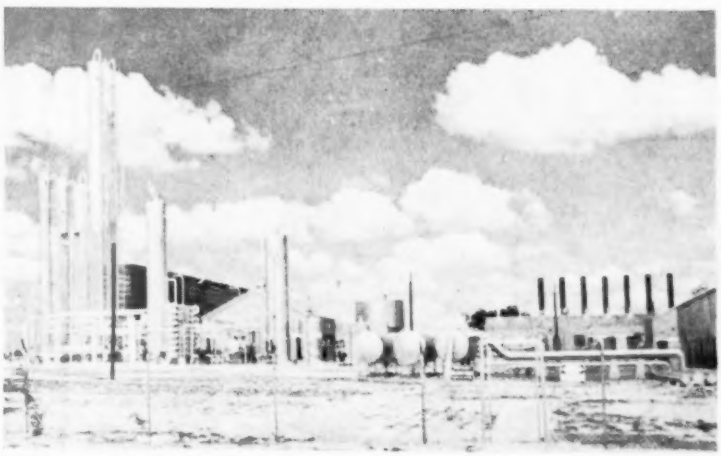
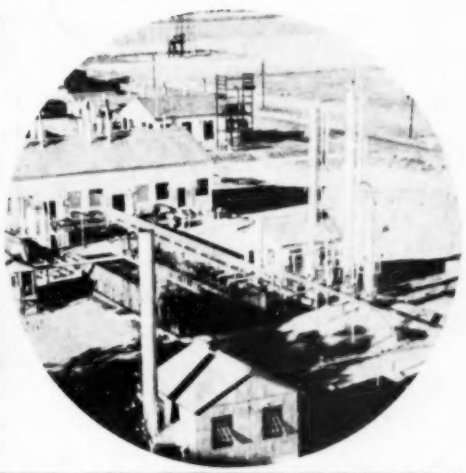
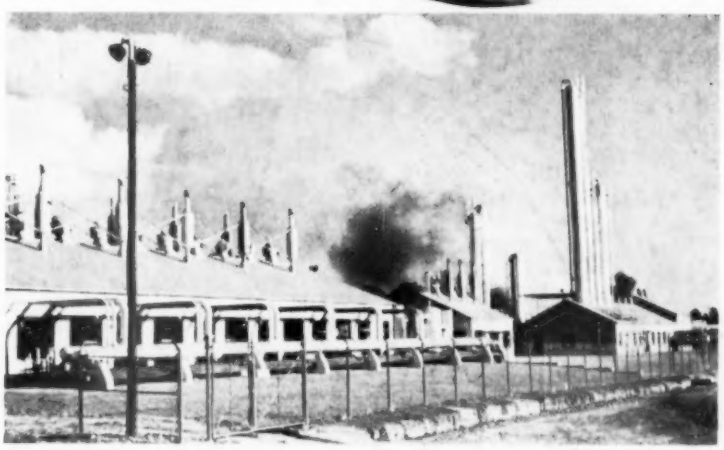
'Plant a Year' Since 1934 Is Warren Petroleum's Record







Last three plants built by Warren Petroleum are (above) the Hawkins, Tex., plant, 1943; (in circle) the Griffin, Ind., plant, 1944; and the Crossville, Ill., plant, 1942 (at right). Construction was started on another plant in 1945

Warren Petroleum Corp. has built a new natural gasoline plant each year since 1934, and has another under construction now. It has been the company's policy, when closing a plant, to scrap it rather than to move it. The new plants thus are built of new materials and include new equipment in order to take advantage of the operating economies of progressive modernization.

This week's National Petroleum News features an article on Warren Petroleum and the Hanlon-Buchanan companies which Warren purchased last month for about $12,000,000. Included in the article are biographical sketches of the men who built and operated these natural gasoline companies and who have contributed much to the natural gasoline industry. Page 22

★

HOUSEKEEPING, merchandising and service of top quality are resuming their prewar rank in the field of service station operation. The value of on-the-job training in reviving this standard of service is recognized by oil company sales officials. What one major company is doing in its rejuvenated service program is told on p. 38

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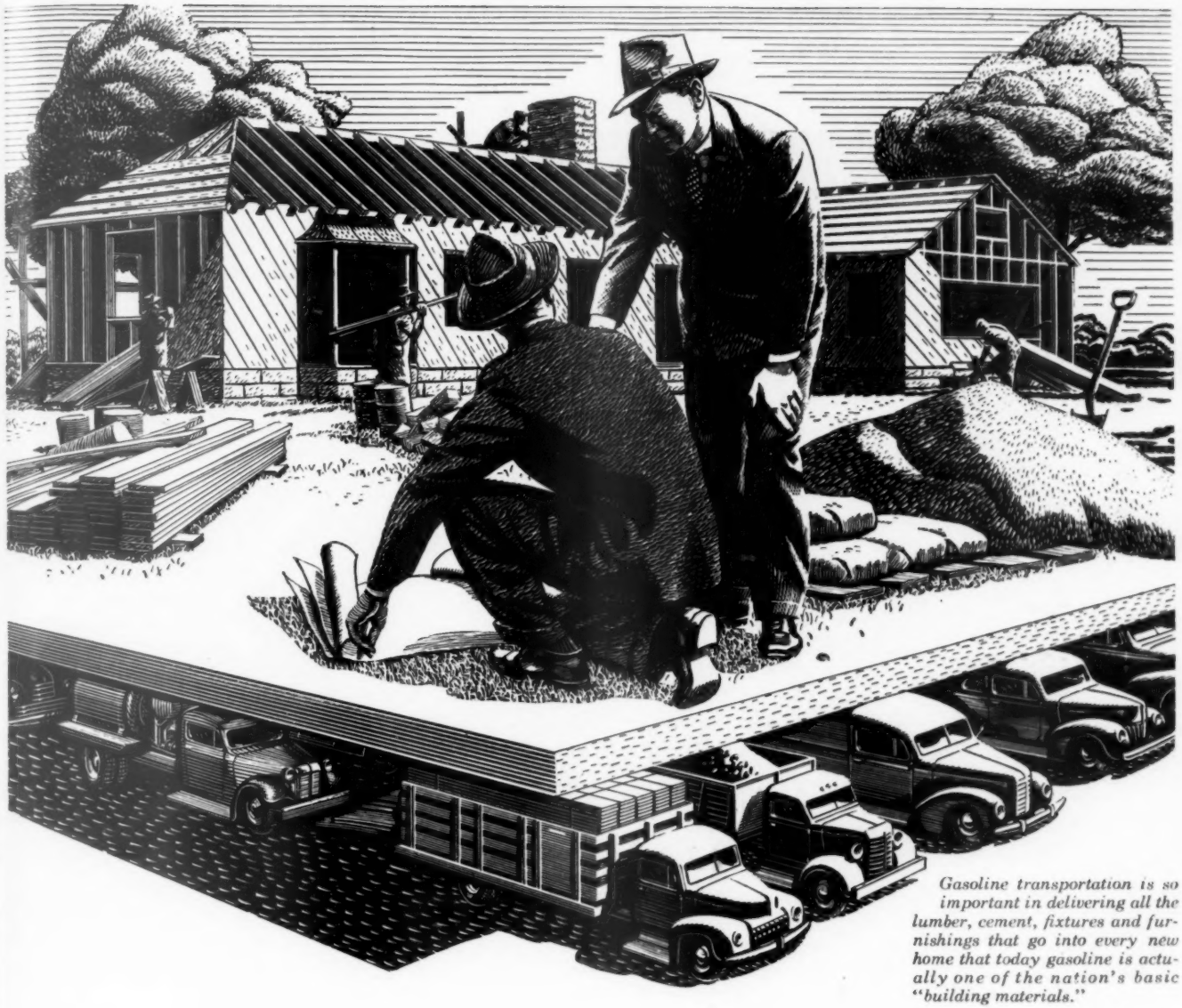

Gasoline transportation is so important in delivering all the lumber, cement, fixtures and furnishings that go into every new home that today gasoline is actually one of the nation's basic "building materials."

Houses are built on gasoline

BUILDING is an assembly job. Before a house can be put together, it has to be brought together—lumber, bricks, cement, pipes, pre-fabricated sections and other materials delivered to its site by motor truck. Better, faster automotive transportation helps builders do a better job—just as it helps the people in every other industry and business.

Over the years the nation has benefited from many improvements in gasoline transportation. Through improved refining methods and the use of antiknock fluid made by Ethyl, oil companies have produced increasingly better gasolines. And each advance in gasoline quality has made possible the design of more powerful, more efficient engines for automotive vehicles of every kind.

The quality of gasoline generally available at filling stations is a big determining factor in the design of automobile engines for any particular year. If gasoline progress should for any reason be retarded, progress in the entire field of automotive transportation would suffer. But as long as refiners are able to supply the nation with finer fuels, the automotive industry will make sure that America receives the benefits of better transportation at lower cost. Ethyl Corporation, Chrysler Building, New York 17, N. Y.

More power from every gallon of gasoline through

ETHYL

Research · Service · Products

He Gave Away Coal Shovels–and Sold More Oil Burners

W. A. Matheson

Giving away free coal shovels to promote the sale of oil burners may sound like something dreamed up after a midnight snack of rarebit.

W. A. Matheson, manager of the Chicago branch of Williams Oil-O-Matic in the 1930's, thought up the idea and the only nightmarish aspect of the entire scheme was the restless nights it gave his competitors. And it serves as an example of one of the qualities which in 1945 landed him in the president's chair as head of Oil-Heat Institute, a position he still holds.

But to get back to his coal-shovel deal. Acclaimed as the most spectacular and original sales stimulator ever seen by the heating industry, the Matheson campaign started off with a full-page advertisement, in color, offering top quality shovels free—to those who professed that they really liked to shovel coal. By the time his competitors had caught their breath, Mr. Matheson's salesmen had delivered 5,000 free coal shovels.

The punch-line in the campaign didn't become evident until the shovels had been put to use. Each salesman had been well drilled in what to say when he presented a shovel. Then to make the follow-up complete, this message was branded on the shovel handle:

"Oil-O-Matic costs less—no shoveling!"

Yes, it sold oil burners, and it helped boost fuel oil sales.

Mr. Matheson, vice president and director of Eureka Williams Corp. of Detroit and manager of Williams Oil-O-Matic Division (Bloomington, Ill.) as well as Oil Heat Institute head, is a native of Oregon City, Ore. After World War I he migrated to British Columbia where he built up his first business, a shingle bolt concern, only to have the roof cave in under the combined weight of over-expansion and the depression of the early 20's.

Returning to U. S., Mr. Matheson's first job was as sales manager for an ice cream company in Portland, Ore. Shortly afterward he moved to Seattle to become sales manager for Power Plant Engineering Co., which provided his first contact with the oil heating industry and with Oil-O-Matic since the company was distributor for Oil-O-Matic burners. After three years in Seattle, Mr. Matheson went with Hart Oil Burner Co., Peoria, Ill., serving as sales manager from 1926 to 1930.

From Hart Oil Burner he went to Williams Oil-O-Matic as manager of the Chicago branch. It was during this sojourn in the Windy City that he staged his free coal shovel campaign.

Next on Mr. Matheson's itinerary was the post of New York branch manager of Delco Appliance Division, General Motors Corp. It was in 1940 that he returned to the Williams Co., this time as vice president and assistant to the president and a company director. In December the same year the company was given its first defense assignment—the production of hydraulically controlled, automatic antiaircraft firing mechanisms. When war came company facilities were devoted 100% to production of vital war equipment. Company was awarded Army-Navy "E" 5 times and also merited USAAF "Approved Quality Control Rating" with renewal.

In 1944 Mr. Matheson became company president.

When, in 1945, Williams Oil-O-Matic merged into the Eureka Williams Corp. of Detroit, Mr. Matheson became vice president and a director of the corporation and manager of the Williams division of Eureka.

He had served on the Executive Committee of Oil-Heat Institute of America, Inc., since 1941, and in May, 1945, was elected president of OHI. In April of this year he was re-elected for a second term (see NPN May 1, p. 13).

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NATIONAL PETROLEUM NEWS
NPN
NEWSMAGAZINE FOR OIL MANAGEMENT MEN

Decrease in Prices for Tires, Batteries Foreseen by TBA Men at Chicago Session

Ample Production Facilities Basis for Prediction; Oil Changes, Motor Tune-up Stressed by Speakers

NPN News Bureau

CHICAGO—Lower prices for tires, batteries and other TBA equipment, and budget selling in the approaching highly competitive market were predicted by speakers at meeting of about 75 oil company TBA men at the Blackstone Hotel here May 27-28. Oil changes and motor tune-up were described as the key to TBA business.

Despite current lead shortage and belief that this shortage will continue so long as government controls persist, Harry G. Barnes, National Battery Co., foresaw lower battery prices. Getting into "pay dirt" where the industry has something to say about what takes place —that is, freedom from government control—he said that with declining markets, there would be plenty of battery production facilities. He saw price drops to $3.15 or even $2.98 for some makes of low-capacity batteries.

He suggested that now is the time to train salesmen to leave the low-ball battery to others who have nothing better to offer, although he did not believe that the competitive battery was going to appear immediatey.

Discussing trends in tire marketing, V. D. Kniss, manager of tire sales for Firestone, predicted many changes to come, probably before expected or even desired by some. He told NPN that Firestone has all of the company-owned retail outlets they want, but that in his opinion, competition in local areas probably will determine whether tire industry generally in the future works more closely with independent oil jobbers or competes directly for service station dealer business.

Predicts Brand Preference Switch

In his TBA address, he said that Firestone has decided to put all of its resources behind its branded products to strengthen its dealers' positions and not dilute their business by introduction of competing lines of tires. He predicted an industry swing from private brands to brands of manufacturers, and with a larger number of sizes and types of tires, even a variety of colored tires to harmonize with automobile colors.

Number of private brand tires sold through oil company outlets climbed from .8% or 350,000, in 1929, to 7%, or 2,937,000 tires in 1940, according to estimates, he said. Since that time, the combined private and special brand segment of the oil company business has been increasing. Among reasons given for predicted trend toward manufacturers' brands, was larger number of sizes, and tires made for special purposes, like motorcycle tires, farm tires and tires for earth moving equipment, and items like anti-blowout tubes, not available as private brand merchandise.

"Changes in tire designs, sizes and types, the bringing back of white sidewall tires, the probability of additional lines of tires, including premium tires and tubes, have only been delayed," he declared . . . ."and we see the idea of even colored tires being brought into the picture."

"Putting the farm on rubber," he continued, "is becoming more of a reality than even we, in the rubber industry, anticipated.

In addition to tractors, he said, farmers are putting combines, threshing machines, manure spreaders and other equipment on rubber. Discarding steel lugs for rubber, gives tractors freedom of the highways. Government construction of irrigation and flood protection projects require other tire sizes and types.

"I am giving you this picture," he said, "because it indicates the extent and importance of obsolescence in the near future."

The tire of tomorrow, he went on, may be made of greatly improved cotton, rayon, nylon, wire or spun glass. Firestone is testing these materials now. Cotton cord now being used has tensile strength of 18 lbs, while popular 22.00-2 rayon has 34 lbs., and experimental wire, 190 lbs. Using cotton at 100% for relative efficiency on strength versus thickness of the tire, the rayon tire is 179% and the wire tire, 498%.

Problem facing tire retailers in the immediate future was given as necessity for carrying bigger stocks with consequently larger investment, smaller turnover and larger storage space. He does not believe that dealer stock of a few 6.00—16's and 6.50—16's will be sufficient as many new cars are coming through with 6.00—15's or 6.50—15's, "and some of the new smaller cars projected will have 5.50—15's and perhaps even 5.00—15's."

Because of war experience and longer lasting tires in the future, recapping was declared an important factor in tire sales.

Opportunities for Oil Men

He urged the oil company TBA men to take advantage of their good war reputation, grasp opportunity and really get into the tire business. Oil companies have a real opportunity in the farm market, he declared, because of convenient location of rural stations.

Anticipated tire sales this year total about 85 million of all types, and, Mr. Kniss said, next year's sales will be almost as high. Industry manufacturing capacity was placed at 115 million pneumatic tires compared with 90 million annually before the war. After 2 or 3 years, he thought, annual sales would settle down to about 75 million.

The shift upward in family income groups, as projected by Harry Goodenberger of B. F. Goodrich Co., will affect installment buying, most of which comes within the $3,000 annual salary bracket and below. Data compiled from government figures by Goodrich's business research department, however, shows that take home wages have not kept pace with gross wages. Average weekly wages of factory workers prewar was $26.54, all of which was take home pay. The 1945 average gross wage was $44.86, but only $32.86 was take home pay. Thus, with an increase of 69.4% in gross wages, take home pay has increased only 23.8%, compared with 30% increase in the cost of living.

Goodrich figures show that in 1941, 84.9% of the total population received annual incomes of $3000 or less, and

Name TBA Regional Heads

NPN News Bureau

CHICAGO — Group of oil company TBA men elected four regional chairmen in lieu of a national chairman at their meeting in the Blackstone Hotel May 27-28. Dan Breen, Skelly Oil, Kansas City, was elected general secretary for the whole group. The regional chairmen are:

W. M. Schmitt, Sun Oil, Philadelphia—Eastern.

C. W. (Bill) Henking, Pure Oil, Chicago,—Midwest.

T. M. Davis, Arkansas Fuel, Shreveport—Southwest.

R. S. Davis, Shell Oil, San Francisco—West Coast.

15.1% were above the $3,000 bracket. In 1944, the figures were 73.5% below and 26.5% above $3,000.

Examining liquid savings, Mr. Goodenberger said that 75% of our entire population owns only 13.8% of the nation's wartime cash savings; that is, the 73.5% of the total population with incomes of $3,000 and less, owns only 13.8% of total savings and will not have sufficient take home pay and cash on hand to buy what they will want, and will create demand for installment buying.

Mr. Goodenberger pointed out that most time payment buyers are good risks, but that oil company credit cards are not a substitute for time payment plans. "They are a team, and work together," he said, adding, "cash customers belong to anybody—credit buyers belong to you."

Requires Equipment, Experience

William G. Ball, Jr., assistant sales manager of promotion department of Ethyl Corp., told the TBA group that motor tune-up requires plenty of equipment and experience. He did not think it should be taken on unless it will increase, and not decrease, sales of gasoline and motor oils. He described tune-up as a systematic necessity—not just sales promotion.

"It is impossible to learn tune-up from a book," he declared. He suggested 8 steps essential to a good tune-up program. They were:

1. Set up an advisory committee composed of men from retail sales dept., TBA, advertising, etc.
2. Make tune-up equipment available to dealers by sale or rental.
3. Have a motor check sheet for dealers.
4. Establish a company policy for sale and distribution of TBA.
5. Sponsor a uniform tune-up procedure and training instructor to train dealers.
6. Supply a refresher course on tune-up.
7. Select tune-up dealers from a service station survey of facilities.
8. Present the dealer with a tune-up program in a package.

L. D. Grant of Chek-Chart Corp., in discussing motor tune-up principles, equipment and procedure, told TBA men that tune-up ranks high on the list of regular services to motorists—probably third—and brings additional TBA and premium fuel and lube sales and customer satisfaction.

"The good tune-up salesman," he said, "finds opportunity to sell batteries, battery cables, mufflers, tail pipes, tires and tubes, windshield wiper parts, and even sundry articles such as polishes and household items."

He described tune-up as means of restoring original performance and economy to a car—not just repair of electrical units—and declared a competent operator was an absolute necessity, and modern precision equipment essential.

TBA departments can control instruction and bind operators to them by supplying competent material on tune-up covering principles and procedure, Mr. Grant said.

He pointed out that a 2-bay station is the smallest that should contemplate tune-up work in order to avoid tying up lubrication jobs, and suggested advance scheduling of jobs according to the time required for each. Tune-up jobs fall into two classes, he said, which consist of:

Minor: Check and adjust contact points
Adjust automotive spark advance governor
Adjust vacuum spark control
Adjust cam angle
Retime engine
Clean, regap and test spark plugs
Test and inspect spark plug cables
Clean gas filter bowl
Clean air cleaner
Adjust carburetor.

For a major tune-up add the following:
Check and adjust automatic choke
Test fuel pump
Test compression
Test coil and condenser
Test valves with vacuum gage
Tighten manifold
Adjust generator output
Test starter.

"The potentials in tune-up are great," he declared, "and they are very much like a ripe plum ready to be plucked."

H. L. Hemmingway, assistant technical advisor to the marketing department, Pure Oil Co., using illustration picture slides, showed TBA group how changes in motor fuels, lube oil and engine design will affect replacement parts of motors. Before the war, he said, there was a trend toward smaller and smaller crank case capacities, but that has been reversed for postwar cars.

One slide showed a paper cartridge type oil filter, which Mr. Hemmingway said initial tests indicated was quite effective as it will remove finer particles then the general type filter.

OPA Suit Against Texas Co. Postponed Now to Sept. 16

NPN News Bureau

CHICAGO—Trial of OPA's suit against The Texas Co. for alleged violations of ceiling prices was postponed this week until Sept. 16 because of a crowded docket in Federal Judge Michael L. Igoe's court here.

Company attorneys said that OPA has asked dismissal of 65 of the 110 claims in the suit. David Dockman, OPA enforcement attorney, said dismissal of the 65 small items, totalling less than $2,000, would shorten the trial.

API Farm Committee Meet Set

NPN News Bureau

NEW YORK—API's Agricultural Development Committee, whose meeting schedule for May 15 was postponed, will meet at Hotel Stevens, Chicago, June 11-12, according to notification sent to members June 4.

Plans $18 Million Refinery Expansion

Special to NPN

BARTLESVILLE, Okla. — Cities Service Oil Co. last week revealed plans for $18,000,000 expansion of its East Chicago refinery, including newest type of fluid catalytic cracking unit which will increase capacity to 35,000 b/d.

W. Alton Jones, president of company, said entire job will be under supervision of M. W. Kellogg Co., and is scheduled for completion in spring of 1948.

In addition to East Chicago, now rated at 30,000 b/d, Cities Service operates 7 other refineries—Lake Charles, La., 100,000 b/d; Ponca City, Okla., 11,000 b/d; Linden, N. J., 13,000 b/d; Petty's Island, N. J., 20,000 b/d; Titusville, Pa., 3000 b/d, and East Braintree, Mass., 20,000 b/d.

Mr. Jones said installation of new fluid cracker at East Chicago, in addition to 3 already operating at Lake Charles, will make Cities Service one of largest users of this type of catalytic cracking equipment in world. Other new equipment in East Chicago expansion program will be feed preparation unit, polymerization plant, gas recovery equipment, additional tankage for both crude oil and finished products, increased steam generating capacity and enlarged laboratory, pump house and change house facilities.

3-Million-Gallon Terminal Opens at Vicksburg, Miss.

Special to NPN

VICKSBURG, Miss. — Three-million-gallon marine oil terminal of Moore Oil Terminals on Vicksburg River was formally opened for operations here last week. Terminal is one of two constructed by Moore at an approximate cost of over $100,000 each. Second terminal is located at St. Marks, Fla., 20 miles south of Tallahassee. Operations also are underway at Florida facility.

Terminal here is staffed by oil veterans and will serve Mississippi, Alabama, Louisiana, Arkansas and Tennessee jobbers and distributors with gasoline and petroleum products. Facilities here are managed by S. E. Towery, assisted by Watson A. Sudduth, returned war veteran. Dale W. Moore of Houston is president of Moore Oil Terminals.

Supplied by chartered boats and tows of Texas Towing Co. of Houston, Vicksburg terminal brings to this trading area the economies of water transportation from nearby Gulf Coast refineries. Products handled include ethyl and regular grade gasoline, kerosine, tractor fuel, Diesel, heating and lubricating oils.

Roadside level truck-loading racks have been constructed on U. S. Highways 61 and 80 so that trucks may be serviced without making a heavy pull against the river grade. Racks are serviced by specially-constructed pipeline from storage tanks along the river.

Continued Curbs on Tetraethyl Lead Loom Even Though OPA Action May Spur Output

CPA Lowers Octane Ceiling to 78.5; Conservation Measures Necessary for Some Time, Agency Warns

NPN News Bureau

WASHINGTON—The gloomy prospect of continuing curbs on the use of tetraethyl lead for months to come was held out this week by the federal government.

Even as OPA belatedly authorized a price increase which may unlock the door to settlement of the wage disputes throttling production in domestic lead mines and smelters, CPA was pointing up the basic metal shortage by lowering the octane ceiling on leaded premium gasoline to 78.5 and further amending L-355, the Ethyl fluid use order.

CPA took the view that enforced conservation measures will be necessary for "a considerable time" despite the possible early ending of the mine and smelter strikes, because it would take weeks to get output back to the annual normal rate of 500,000 tons of pig metal.

Besides dropping the octane limit on leaded premium 1.5 points from the former level of 80, CPA made these other changes in L-355, effective June 1:

1. Restricted deliveries of Ethyl fluid in any one calendar month to not more than 24% of the aggregate amount of motor Ethyl fluid delivered to a refiner during the base period (last November, December and January), except when a refiner certifies that he used more fluid than was delivered in the base period. In latter event, deliveries are restricted to a quantity not exceeding the total of 22% of Ethyl fluid used in the base period in premium production and 27% used in the base period in housebrand blending.

2. Reduces monthly use of Ethyl fluid to total of 22% of fluid used in base period in premium blending and 27% of Ethyl used in base period in housebrand production. Refiners' consumption quotas can be used in either housebrand or premium blending without regard to percentage uses in base period.

3. Permits refiners to carry over to succeeding months all unused portions of consumption quotas, but not delivery quotas.

CPA's Chemical Division, administrator of L-355, said the Ethyl Corp. had been authorized to process 4,200-tons of raw metal during June to meet permitted uses of Ethyl fluid. The 4,200-tons of metal will come out of Ethyl Corp. stocks, which CPA said were built up to a high mark during wartime.

Would Get 'Hunting License'

When these stocks reach a 30-day working level, as required by CPA, the agency said Ethyl would be given "permission" to buy additional unprocessed metal on the open market or through the Metals Reserve Corp. At present, however, such permits amount to little more than a "hunting license" in many cases, CPA said, pointing out that most end-users of the basic metal are able to find only about one-half as much metal as they are authorized to use.

As for possibility of increasing the short supply of lead by boosting imports, one government official said the U. S. currently is importing as much lead as "politically feasible." It was explained that imports in 1946 will reach about 100,000 tons as compared with purchases on foreign markets at a yearly rate of about 15,000 tons prior to the war.

Imports during the war years were stepped up by the U. S. because of military needs and because European buyers were cut off from markets.

Because of increased uses of metallic lead and because of the loss in supply during the lengthy mine and smelter strikes, CPA believes that supplies will continue short for some time.

"Domestic lead production is currently at a rate less than 50% of normal 500,000-ton production," CPA said. "Lowered imports and declining receipts of scrap are also aggravating the supply situation. Because of these many adverse factors, the 880,000-ton supply estimate for 1946 (made at first of year) must be revised sharply downward."

Government officials said price increases on lead, effective June 3, will have no effect on the world market price of raw metal because the U. S., through Metals Reserve Corp., has met the world price in its purchases. Sales to domestic and private users are made by the metals agency, with the difference in OPA ceilings and international price made up by a government subsidy.

In its price action, OPA advanced ceilings on both pig and secondary lead 1¾ cents per pound. Former ceiling in pig lead at New York City was 6.5c per lb. and the increase boosted it to 8¼c.

Prices on lead scrap were raised but, because of increased smelting costs, by only 1.55c per lb. instead of the full 1¾c granted for primary and secondary metal. Prices of battery lead scrap also were increased.

The boosts in lead ceiling prices followed the Wage Stabilization Board's recent recommendation of a wage increase of 18½c per hour for mine and smelter workers.

Like Tool Owners Union

Special to NPN

LEXINGTON, Mass. — Tool Owners Union, headed by A. W. Rucker, has been swamped with membership applications as the result of running full-page advertisements in the *New York Times*, *New York Herald-Tribune* and the *Lexington Minute-Man*.

Mr. Rucker also reports receiving many membership applications as the result of NPN Editor Platt's editorial in the May 1 issue.

Standard Oil Co. (Indiana) Boosts Prices on Gasoline

NPN News Bureau

CHICAGO—Standard Oil Co. (Indiana) this week announced a 0.3c advance in gasoline prices generally throughout its marketing territory, effective June 5, and issued the following statement:

"Standard Oil Co. (Indiana) today (June 3) authorized its representatives in Michigan, Indiana, Illinois, Wisconsin, Minnesota, Iowa, Missouri, Kansas, Nebraska, and the Dakotas to advance normal and sub-normal consumer and dealer tank wagon prices on all grades of motor and aviation gasolines three-tenths of a cent a gallon on Wed., June 5.

"This increase reflects increases in the costs of making gasoline and the usual seasonal stiffening of demand. It wipes out a reduction which the company announced on Jan. 10.

"OPA approval of the increase was not needed because in no case will the new prices be above the official ceilings."

OPA Authorizes 9% Increase In Tin Cans for Grease

NPN News Bureau

WASHINGTON—OPA has authorized a 9% increase over the March, 1942, price for so-called general line tin cans used for packing greases and various other products. Action affects all varieties of tin cans and containers, effective June 4.

Agency also restored price controls on all glass containers, jars and bottles, for industrial as well as other products, effective June 8. Most glass containers had been suspended from control last April 8.

Provides Price Adjustments

WASHINGTON—OPA has provided for adjustment of seller's maximum prices for lubricating oils and greases up to fair trade price provided in state laws, without necessity of court injunction, upon application and showing by seller that his maximum price is below fair trade price generally in effect during March, 1942. Action was taken in Amendment 4 to MPR 510, effective June 10.

API Filing Deadline Postponed

WASHINGTON—Justice Department has consented to another postponement in date for filing answers or pleas in government's antitrust suit against API and various companies, this time to July 22.

This Navy Torpedo bomber trails a magnetic detector, revealed this week as a secret weapon which locates submarines underwater. Originated in Gulf Oil research laboratories, device helped win the Battle of the Atlantic. In peacetime use, it charts the earth's underground magnetic structure. As the first practical, airborne prospecting device it opens to oil exploration hitherto inaccessible jungle, mountain and ocean regions and will tremendously speed up discovery of the world's remaining oil resources.
(Official Navy photo)

'Flying Eye', Which Helped Defeat Axis Subs, Expected to Open up Era of Aerial Oil Surveys

Special to NPN

PITTSBURGH—An airborne magnetometer, developed in 1940 in Gulf Oil Corp. laboratories to speed oil exploration and then transformed into a wartime weapon to hunt out enemy submarines, now is being applied to its original field, that of aerial oil surveys.

Gulf Oil this week said it expected the "flying eye" to speed up tremendously discovery of the world's remaining uncharted oil resources. Instrument, company stated, represents the first practical means of oil surveying from the air.

In preliminary oil surveys it gives a continuous magnetic chart, in grid style, over hundreds of miles of difficult terrain in a few hours, where ground prospecting might require weeks or months. And, Gulf claims, it introduces the only means of magnetic prospecting over water.

Research on instrument, basically a magnetic detector which could be airborne, was begun in Gulf laboratories in 1940 and a successful test flight made in early 1941.

Possibilities of the "flying eye" for detecting submarines were suggested by its originators to the government, which granted Gulf a contract to develop this adaptation. First submarine hunting model went into operation in December, 1941. Built around a sensitive magnetic detector to record for the geologist the intensity of the earth's magnetic field, war magnetometer was adjusted to signal the presence of a submarine by indicating a disturbance in this field.

Rushed into production by the originating scientists themselves, first supply of instruments was delivered to Navy in time to help in submarine battle off Atlantic Coast in 1942, and a number of enemy undersea craft were sunk as a result of "flying eye" detection.

Not new in principle, a ground magnetometer was widely used in early oil prospecting. By inferring the position of the highly magnetized basement, or igneous rock, it gave oil geologists considerable information about oil-bearing formations lying above the basement. In the early and middle 30's it was largely superseded by more accurate gravimeter and seismographic survey procedures.

Airborne Use Most Important

Once adapted for use in flight, however, the usefulness of the magnetometer broadens tremendously. Earlier ground magnetometer had to be mounted on a solid platform, because of its easily disturbed sensitivity. Until Gulf's development, none had been devised suitable for use in a moving vehicle.

With accuracy as good or better than any similar instrument on ground, the airborne magnetometer is expected to speed up and add to the efficiency of preliminary oil surveying.

In a matter of years "flying eye" may enable surveying of regions that would require decades by foot expedition. Unpromising areas can be eliminated and the more accurately diagnostic geophysical prospecting methods can be concentrated in regions of high probability.

Of all means of geophysical prospecting, "flying eye" alone provides a continuous record of territory surveyed, Gulf points out. It also offers only means of magnetic mapping over areas where erratic surface magnetic influences make ground readings unusable.

As the only method of magnetic prospecting over water, instrument opens vast unexplored stretches to the oil geologist. Its first job for Gulf will be in flying over areas off-shore in the Bahamas.

Present instrument, which is electronically operated, rides in bomb-like casing trailed beneath the plane to eliminate magnetic interference.

It is expected that the airborne magnetometer will be made available to the oil industry generally in the reasonably near future.

Patent Entanglements Hold Up Magnetometer

NPN News Bureau

WASHINGTON — Although airborne magnetometer, employed in exploration of Navy's Alaskan oil reserve and Continental Shelf survey in Gulf, is newly revealed as having been used by Navy during war to seek out submerged enemy submarines, patent tangle remains barrier to licensing for manufacture for commercial purposes.

Technical information on development is scheduled for release July 1, but manufacturers receiving this information will be advised use of it may involve them in legal difficulties. Only security wraps have been removed by Navy.

Actually, two types of magnetometer were developed in co-operative work through war years, and various interests involved include at least two electrical manufacturers, as well as Gulf Oil Corp.

A joint Army-Navy committee seeking solution to multi-million-dollar problem blocking commercial use of many wartime electronics developments recommended few months ago that co-operative non-profit organization be set up to administer patents and license manufacturers to take advantage of radar program developments, but plan was dropped when Justice and Commerce Departments disapproved.

Airborne detector has been employed in test surveys of more than 40,000 square miles of territory during last two years by geological survey, chiefly in cooperation with Office of Naval Petroleum Reserves. Principal operations, at heights of from 150 to 14,000 feet, have been over Naval Petroleum Reserve No. 4 in Alaska and 160-mile stretch of Continental Shelf off Texas - Louisiana Coast.

3rd Quarter Motor Fuel Demand Revised Upward; Total 1946 Estimate Set at 761,000,000 Bbls.

NPN News Bureau

WASHINGTON—Third quarter demand for motor fuel was estimated at 206,000,000 bbls. in Bureau of Mines forecast this week which revised previous estimates of crude and refined products requirements sharply upwards and pegged total 1946 demand for gasoline at 761,000,000 bbls.

Latter figure compares with a total demand during last prewar year, 1941, of 694,586,000 bbls., and includes a requirement for automotive gasoline of 572,000,000 bbls.

Bureau likewise estimated total 1946 requirements for crude and principal other refined products as follows:

Crude—1,762,000,000 bbls., compared with 1941 domestic production of 1,402,228,000 bbls., plus imports of 50,606,000 bbls.

Distillate and Diesel fuel oils—271,000,000 bbls., up 42% from 1941.

Residual fuel oil—496,000,000 bbls., up 25% over 1941.

Total demand for all oils for the year was estimated at 1,910,000,000 bbls. (an average of 5,233,000 b/d). This compares with 1941 demand total for all oils of 1,594,609,000 bbls.

To meet estimated demand for this year, Bureau forecast need for domestic crude production of 4,611,000 b/d, approximately 10% higher than previous forecast of 4,181,000 b/d by PAW. Demand for most refined products generally was up about 10% from PAW's last estimate.

Discussing the stock change picture, Bureau said a material reduction in gasoline stocks and increases in fuel oil stocks during the year "should avoid the abnormal re-adjustments in refinery operations that were necessary to meet requirements in the first quarter of the year."

Sees 'Moderate Downward Trend'

Bureau conceded that the "most uncertain factor" in its forecast was estimating refinery operations during the latter part of 1946, but assumed that a "moderate downward trend" would prevail. However, it hedged on the forecast with a statement that, "if demand proves to be higher than anticipated and the seasonal increase in fuel oil stocks is inadequate crude demand and runs to stills may be sustained at second quarter levels."

"From present indications, the average demand for domestic crude petroleum in the second quarter," Bureau estimated, "should approximate 4,670,000 b/d. This demand reflects continuation of a high rate of motor fuel consumption and the necessity for rebuilding depleted fuel oil stocks."

Other Forecasts

Details of other forecasts by Bureau on basis of entire year 1946 follow:

CRUDE — Production, 1,683,000,000 bbls.; imports, 83 million; stock changes, plus 4 million; total demand, 1,762,000,000. Crude runs, 1,691,000,000; exports, 34 million; fuel and losses, 37 million.

ALL OILS — Production, 1,796,000,000; imports, 131 million; stock changes, plus 17 million; total demand, 1,910,000,000. Exports and shipments (including shipments to foreign and noncontiguous territories of U. S., but excluding consignments to armed forces outside continental U. S.), 168 million; military (including only new liftings from continental U. S.), 100 million; ocean bunkers, 98 million; civilian, 1,544,000,000.

DISTILLATE AND DIESEL—Yield, 15.9%; production, 269 million; imports, 5 million; transfers, 4 million; stock changes, plus 7 million; total demand 271 million. Exports and shipments, 34 million; military, 25 million; ocean bunkering, 8 million; railroads, 14 million; gas and electric utilities, 10 million; all other uses, 180 million.

RESIDUAL FUEL OIL — Yield, 26.3%; production, 445 million; imports, 40 million; transfers, 18 million; stock changes, plus 7 million; total demand, 496 million. Export and shipments, 8 million; military, 55 million; ocean bunkering, 90 million; railroads, 95 million; gas and electric utilities, 40 million; other civilian uses, 208 million.

CPA Deals New Setback to Non-Housing Projects; Orders Cut 2/3 in Dollar Volume for 45 Days

NPN News Bureau

WASHINGTON—To bring non-housing construction authorizations into balance with supply of building materials and to provide more materials for veterans' houses, CPA has ordered its field offices to reduce dollar value of non-residential building permits by two-thirds for at least next 45 days.

(These limitations apply only to construction which is restricted under Veterans Housing Program Order 1. They have no effect upon expenditures for equipment for which no authorization is required—See NPN, May 1, p. 3)

Reduction in authorizations will be based on permits in CPA districts for two-week period ending May 23. CPA will permit its regional directors to take into account exceptional circumstances and to vary reduction rates between districts, if necessary, but emphasized that two-thirds slash must be carried out in region as a whole.

"This action was taken," CPA explained, "because of large volume of construction already under way or authorized, and impact of strikes on production of scarce building materials. Effect of action and availability of building materials will be reviewed at end of 45-day period to determine if it may then be possible to relax new criteria for authorization of nonhousing construction."

In absence of unusual circumstances involving "exceedingly severe hardship," CPA said only projects which fall within following conditions may be approved:

1. Projects vitally necessary to public health and safety.
2. Projects which will increase production of critical products listed on Schedule 1 of Priorities Regulation 28. (No petroleum products listed on schedule).
3. Projects essential to increased food production or preservation.
4. Projects providing minimum community facilities absolutely necessary for new residential areas developed as part of veterans' housing program.
5. Projects providing urgently needed veterans' educational facilities.
6. Essential and non-deferrable maintenance and repairs.
7. Projects having no impact whatsoever on housing program.

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NPN News Bureau

CHICAGO—A poll of eight CPA district offices in the Midwest indicated that most applications for oil industry construction will be denied during the next 45 days, when boards will reduce sharply approvals of nonhousing construction.

Although CPA district offices have not classified applications according to industry, Chicago office stated that from May 23 to 30, 90 approvals for all types of construction were granted for a total of $5,763,000. During the same period, 56 applications totalling $6,975,000 in construction were rejected, it was said.

Figures of approvals and rejections were not available from other offices located throughout the Middle West, but as one field office reported, "with approvals held to one-third of previous 50% limitation, not much is left".

Forecast of Gasoline Supply and Demand

(Millions of barrels)

Supply	1st Q.	2nd Q.	3rd Q.	4th Q.	Total 1946
Yield, per cent	37.8	39.3	41	39	39.3
Production from Crude°	157	168	175	165	665
Other sources	20	22	23	22	87
Finished stock changes	+6	—10	—8	+3	—9
Total demand	171	200	206	184	761
Exports and shipments	15	16	17	15	63
Military	5	4	4	4	17
Non-automotive agriculture	9	18	15	9	51
Other-including losses†	11	16	17	14	58
Automotive	131	142	153	142	572

°Other sources include natural gasoline, related products and Benzol blended at refineries or sold directly.

†Losses approximate 2 to 3% of domestic demand.

Rail, Coal 'Settlements' Do Not Solve Problem of Union Power

Settlements of the railroad and coal strikes did not solve the basic problem—that of union abuse of too much power—according to editorials in the current issues of leading business papers in these industries, *Railway Age, Coal Age* and *Black Diamond*. Excerpts from these editorials appear on this page.

A TRUCE, NOT PEACE

When it became politically more dangerous to permit the railroad strike to continue than to suppress it, the administration finally brought its power to bear on the recalcitrant union leaders and the strike came to an end. The strike had become personified in Messrs. Whitney and Johnston to such a degree that their public humiliation at the hands of the administration is quite likely to be accepted as a satisfactory settlement by the government of the issue raised by the strike. It is nothing of the kind. The railroad strike, and the behavior of Messrs. Whitney and Johnston, are *symptoms* of this country's diseased labor relations, not the malady itself. President Truman's proposal for drafting men into the Army to put an end to strikes is a high-handed expedient to afford temporary relief from the lethal symptoms of overdeveloped union egoism, but with no attempt whatever to get at the *causes* of the disease.

These causes are neither hard to find nor hard to cure, given clarity of observation and honesty of purpose. Actual attack on these causes, however, would reduce the power of the political authorities as well as that of the union leaders—which is doubtless the reason why President Truman has proposed that the situation be met by giving *him* dictatorial powers over the unions, rather than by adopting the genuine remedy of trimming union power down to a size where it could not be dangerous and, consequently, would need no dictator to hold reins on it.

The center of all our serious political and economic difficulties—including the current acute labor trouble—lies in one simple cause, namely, the unhealthy concentration of political and economic power in too few hands. There is a preeminent political principle which holds that *power corrupts and absolute power corrupts absolutely*. There is no safety in society for anyone when too much organized power finds its way into the hands of any one man or group of men. Safety exists only when power is distributed, with only a little residing at any one place.

The course President Truman calls for to end this intolerable situation is not that the union leaders be relieved of the unnatural, unreasonable and unprecedented agglomeration of power that political favoritism has heaped upon them, but that the administration be given authority to veto the use of this power, whenever it finds it necessary or expedient to do so.

Whatever may be thought of the judgment of A. F. Whitney and Alvanley Johnston in precipitating a strike on the railroads, it is clear that the blame should rest as much or more upon the politicians who established the conditions which induced them to act as they did as it does upon them. The Wagner Act, and the kind of enforcement given to labor law by New Deal courts and the National Labor Relations Board, encouraged the rise to power of ruthless union leadership—those who applied the tactics of "sit-downs," "mass picketing," and open repudiation of concern for the national interest. This type of union leadership did not originate on the railroads or under the Railway Labor Act, but it *invaded the field of railway labor* and, here and there, took members away from the standard railway labor organizations. It is demanding too much of human nature to expect that a man of the temperament of A. F. Whitney should have sat idly by with his hands folded while his members were being wheedled away from him by union leaders whose selling talk was that they were more belligerent than he.

When the federal government repeals or extensively amends the Wagner Act and the Norris-LaGuardia Act, and otherwise discourages and regulates monopolies of labor as it does those of industrial management and finance, we may know that it is actually dealing with the causes of industrial anarchy and not just trying to hide the symptoms of it. If we permit no concentration of political and economic power outside the government, we shall need no political dictators or drafting of men into the Army to hold this power in check. We shall have no Hitlers or Stalins or Julius Caesars: (1) if we distribute political power as the Constitution says it should be distributed; (2) if we put no class of citizens above the law; and (3) if we will hold the government to the job of governing and out of the domain of producing, pricing and otherwise supervising non-monopilized goods and services.

The temporary respite now given to the railroad industry from active turmoil in its labor relations would be well spent in correcting such working conditions as may justify reasonable complaint and in an effort to promote a better understanding by its employes of the economic facts of the railroads' position. As long as employes hold their present fantastic opinions of the magnitude of railroad earnings, it is small wonder that there is no ceiling whatever on the demands they believe they are justified in making on their employers. —*Railway Age*, June 1 issue.

NEXT STEP?

The terms of the government contract signed on May 29 left Lewis happy and many operators deeply dismayed—and with good reason. For one thing, a reading of the contract leaves the distinct impression that somebody was planning for a long period of government operation—perhaps Lewis, perhaps the government, perhaps both. For another, photographs of the hilarity after the signing reveal no trace of an operator—or of the guy who will have to pay the bill.

The contract was generally assessed as a victory for Lewis—as it was. He was rewarded for putting the screws on, with federal officials apparently preferring to forget the effect on the public's pocketbook and the money and brain sweat poured out over the years by management to render a better service to the consumer and protect the industry's competitive position. But since federal officials do not have to consider the consumer's reaction to higher costs and the effects of his embracing competitive fuels, it is not surprising that they prefer to placate labor leaders. They run true to form, therefore, when they make a contract providing "discipline" for management with no word of union responsibility, raise the cost to the consumer arbitrarily, put management at the mercy of an arrogant union head and give Lewis *carte blanche* to tie up any mine any time without penalty.

The country and the coal industry have suffered heavily for misuse of the power exercised by union leaders with the help and backing of the federal government. Even at this writing, federal officials seemed to be relying more on seizure and appeasement, thereby penalizing the innocent for the actions of the guilty, rather than getting at the roots of the difficulty—the Wagner Act and collateral legislation, administrative partiality and Supreme Court decisions in favor of unioners. The Truman proposal of May 25, in fact, offered nothing to remove the fundamental causes of abuse of union power. That remained for Congress, and particularly the Senate, which at last seemed in a mood to legislate on the side of making collective bargaining a two-way street, curbing unrestricted use of union power, making unioners responsible for living up to contracts and putting public interest ahead of that of union leaders. While legislation still had the veto hurdle ahead, there was reason to believe that the ball had been started rolling in the direction of eventual if not immediate relief.—*Coal Age*, June issue.

A GLORIOUS VICTORY

The contract which a complacent government, profligate with private property and public well-being, has just concluded with the United Mine Workers of America, has been acclaimed as a victory of, by and for John L. Lewis. What a glorious victory it is!

It has cost the nation 90,000,000 tons of needed bituminous coal.

It has cost the nation 18,000,000 tons of needed steel.

It will take the coal miner six years to regain out of his 18½c wage increase (which he could have had without the strike) the wages he lost during the forty-five day strike; six years if the increased cost of bituminous coal to the consumer does not cut down production.

It will take more than the average miner's lifetime to regain the good will lost by the strike.

Bituminous coal, if consumed in normal amount, will cost the public some $200,000,000 to $300,000,000 more per year.

Competing fuels can join the chorus and really claim a major victory without the expenditure of a single dollar.

It was a glorious victory for unionism.

The type of victory the Axis Nations won over the Allied Nations. — *Black Diamond*, June 8 issue.

Editor's Page

Increasing Gasoline Sales Despite Strikes And Shortage of Cars Should Cheer Oil Men

WHILE oil men may justly feel sorry for themselves with their low price, higher cost and other troubles, they are better off than most other businesses, for oil men are selling more goods than ever before when many other big industries are completely or pretty much shut down.

In fact, the big trouble of oil men these days, aside from trying to get OPA to use some price sense, is to obtain new equipment, new construction and rehabilitation of their present plants and equipment, and more trained manpower to take care of the steadily growing volume of consumption. And right ahead is the biggest touring season ever, seemingly. Even though car owners may suffer from strikes and their jalopy fenders may fall off by the roadside, they are buying gasoline—and for cash—and keeping the old car running.

All through its history the oil industry always has done more business year after year, save for 1932-'33 when the big bust came following the boom of the 1920's and gallonage slid off a few per cent, but other businesses dropped large percentages or stopped entirely for months or years or even forever. During the past war period oil marketing had to take a heavy cut, but the industry as a whole went ahead because of the big military demand. These cuts in domestic consumption were somewhat offset by the necessary reduction in expense due to loss of manpower and having to close up the less efficient outlets.

Oil is certainly a vigorous, resilient industry, regardless of its internal price troubles and losses in gallonage battles. In face of the automobile shortage and the nation's strike troubles, the Bureau of Mines estimates that motor fuel demand for 1946 will exceed 1941 by 10%. And the oil industry is able to meet the demand.

Contrast this with other industries:

The automobile industry is practically shut down and may continue so even though coal production has been started up, because of the hundreds of strikes that are holding back parts.

The coal industry has had a long and costly shutdown and is faced with higher costs and uncertain prices.

Manufacturers of all sorts of equipment large and small are down, or running low on account of coal shortage and strikes in parts.

The merchant marine industry is faced with a serious shutdown even though the Navy is able to take over many ships. At best, if the strike goes into effect it will cost much money to shipowners and particularly to those businesses dependent on ocean shipping.

The building industry will probably continue to be in trouble for a long time for lack of materials and manpower and because of government price regulation. This week in Cleveland it is shut down with a carpenters' strike.

The food industry, in all branches, is suffering from loss of volume and threatened in some branches with complete shutdown because of government regulations and prices.

In short there is trouble all around us but the oil industry is keeping right on growing.

Granted we have our troubles. Prices should be higher and margins wider. We need more skilled manpower at reasonable cost, more new equipment, a lot of rehabilitation of old establishments and less threat of government monkeying with the business, but at all events we are operating on an enlarging scale and that, one submits, is a lot better than being shut down.

The reason for our relative good fortune is that we supply the most fundamental transportation and horse power that there is today, and it is the cheapest considering its great flexibility and adaptation to the hour-to-hour needs of every American and his family. Petroleum and its products enable the American today to use to the fullest his personal Independence, yes and enjoy it too.

READERS' comments and opinions will be much appreciated by Warren C. Platt, NPN's Editor and Publisher, Penton Building, Cleveland 13, Ohio.

Radio Advertising Reductions Reflect Postwar Troubles of Business

HOW seriously some large businesses believe they have been disrupted by the strikes and political and economic manhandling of business of the past few weeks, is indicated by the radical reduction in radio programs, such as:

General Motors has ordered its "Symphony of the Air" over NBC discontinued by summer;

Chrysler has canceled its "Music of Andre Kastelanetz" over CBS;

General Electric is canceling its "Hour of Charm";

Lever Bros. its "Bob Burns Show";

General Foods has canceled much of its radio time.

Advertising in other media has also been curtailed. When companies like these pull in their sales effort it is indeed a sad reflection on the character of the times.

Will Oil Have to Carry a Welfare Tax As Result of John L. Lewis' Victory?

THERE are three phases to the strike situation at Washington that well can disturb industry to the point of slowing up its expenditures until it knows more of where the Truman administration is trying to drive this country, or where Truman is willing to let it go under the demands of the unioneers.

Truman handed a practical victory to John Lewis and Al Whitney even though the latter is loudly protesting that Truman gave him the double cross. Lewis got the substantial wage increase on a par with the rest of the country but with some trick clauses on shorter hours of work that seem much to his advantage plus the 5c ton royalty tax

on all coal for the benefit of a welfare fund. Even though Lewis will not be able to administer it on his own say-so entirely he will have perhaps, better than a 50% influence over it because of the very obvious anxiety of the Truman administration to be more than friendly for the labor vote.

The two railroad brotherhoods did well in the settlement as they have been doing well every time a wage dispute arises. These so-called "model" railroad labor laws have been "successes" only because the government has always awarded a victory to the brotherhoods under them. When it appeared it was not a sufficient "victory" then President Wilson or President Roosevelt—and now President Truman—intervened and saw that additional dessert was served the brotherhoods. It is certain that some day those or some other laws will have to be made to work with the public having a real victory and the unions having to take defeat. Only then can it be fairly said that those will be "model" laws.

That Truman settled these strikes for "victories" to the unions, even though the strikes held up the entire country in the most famous style of brigandage, may well cause all business and the country too, to pause and wonder where we are heading.

Then there is the "welfare" fund given Lewis from a straight tax on all coal mined. That idea undoubtedly will be taken up by all unions especially those that can deal on an industry wide basis. However, it is probable that some companies will find themselves faced with demands to put such a tax on the company's products even though competitors, or substitute and competing type of products, do not have to carry such tax.

While the major oil companies have various co-operative employe-employer benefit funds, made up by joint contribution of company and employes, the great bulk of the industry companies and firms do not have such funds, so it is only to be expected that the CIO Oil Workers Union will probably take its cue from Lewis' success with Truman and demand of the entire oil industry an oil welfare fund. Following the Lewis sample, the Oil Workers probably would ask that this be made up by the industry's collecting another tax from the oil consumer. This tax would be in addition to the federal gasoline and oil taxes, in addition to the state, county and such city taxes as are levied on gasoline consumed.

Question, would the industry show that welfare fund tax separately along with the gasoline taxes on the price signs at the pump?

Such as—

Price of Gasoline	12c per gal.
State Gas Tax	5.5c per gal.
CIO Union Welfare Fund Tax	¼c or more per gal.

Or as the price might be shown in Mobile, Ala.

Price of Gasoline	12c per gal.
State Tax	7.5c per gal.
County Tax	2.0c per gal.
CIO Welfare Fund Tax	.25 or whatever it may be
Total	21.75

That would be the only sensible thing to do to relieve the oil industry of the responsibility for such increases in price and the only fair thing to do to keep the public informed as to who is taking a free ride on the sale of gasoline.

That the CIO Oil Workers are thinking of getting more out of the industry is indicated by its recent action in voting to back an amendment to the federal welfare laws to have the federal government increase tax collections enough to permit the Oil Workers to "retire" at 55 years of age.

In addition to notifying the public everytime it buys a gallon of gasoline how much money the buyer is contributing to the CIO welfare fund, the industry will probably have to make some explanation to the AFL unions who, presumably, would not be "cut in" on this plunder. However, if the government caused the latter union to get "its share" then it undoubtedly would be the true responsibility of the oil industry to show the division of each penny of tax collected, in the price posted at the pump.

It is possible that the unioneers won't like this information being passed on to the tax paying victims everytime a purchase of petroleum products is made, but the industry should stand firm in its resolution to give that information to the public just as it finally fought down the "orders" of the office holders "forbidding" posting of the original state gasoline taxes in the early days of those taxes.

By even moderate use of the multiplication table the financial possibilities of taxing petroleum and its products are quite extensive as only a dime a barrel on crude throughput would amount to some $180,000,000 a year and, as it might be said, a dime on a barrel of crude "is only a quarter of a cent per gallon on products."

If government intervenes, as did Truman in the coal strike settlement, and grants such industry taxes for the benefit of individual unions, then it will build up such a strength in these favored unions that Congress will have to step in and take over all such taxing and all such "welfare" funds or else the favored unions will run the country more than ever and that, undoubtedly, will mean something other than nation wide peace.

A third disquieting feature at Washington the past several weeks is Truman's demand that he have a law permitting him to draft both strikers and companies that did not agree to union propositions quickly enough, and to put the profits of those companies into the public treasury as long as the government operated them.

Senator Taft of Ohio, who promptly opposed this demand of Truman's, makes the point that such a draft is entirely too much power to give any president in times of alleged peace but that if a crisis develops, or appears to be developing, that would warrant the use of any such power, then that crisis is of such great scope that Congress should be called together at once to consider it for it would be similar to a war threat. Taft says with today's airplanes Congress can meet on 24 hours notice which should be time enough if a president is at all intelligent in watching for trouble developing. In view of this country's experience with two presidents who have sought more and more unlimited power, it would seem that Taft's idea is far more compatible with American democracy than Truman's.

A disturbing sidelight on this demand of Truman's for being given power to draft both employer and employe is the fact that a few days after it was made Secretary of Labor Schwellenbach, the official who made such a mess of the oil union negotiations last fall and who tried hard to bully the oil companies into granting all the union's demands, publicly served notice on two of the biggest farm machinery companies to make a "real effort" to "settle" their labor disputes by last week's end or he would ask Truman to seize their plants. One cannot but help wonder if Schwellenbach was not disclosing a little too soon perhaps, the real aim of the administration in asking for all this additional power?

Not only businessmen but every citizen probably asks himself, just who is Truman and his administration trying to work for? The good of all America and of all its citizens, or just the labor unions and in return for continuation in office no matter what the cost to America and its liberties?

Munitions Board Eyes Oil Management As Advisor to Military on Preparedness

By Raymond E. Bjorkback
NPN Staff Writer

WASHINGTON — Formation of an oil industry management group to advise the military on preparedness petroleum-wise for a possible future war now is getting specific attention in the councils of the Army and Navy Munitions Board.

ANMB, guiding agency for such bodies as the Army-Navy Petroleum Board, is constituting civilian committees from both management and labor to advise it in its work of formulating plans for industrial mobilization and coordinating such plans between the services.

"The ANMB will rely upon the petroleum board for advice and recommendations in reference to petroleum matters as they affect the services," ANMB's Chairman Richard R. Deupree said this week. "However," he added, "the whole question is under review."

Meanwhile, working committees of the board, either interdepartmental groups or groups drawn solely from the services, are proceeding with programs designed to simplify and standardize industrial mobilization problems. More of these committees are being established.

The board, whose charter calls for a civilian to serve as its chief executive, consists of Mr. Deupree, president of Procter and Gamble and an outstanding industrialist; Undersecretary of War Kenneth C. Royall and Assistant Secretary of the Navy W. John Kenney.

Its responsibilities are exercised through an executive committee composed of Mr. Deupree, who began his service last March, Maj. Gen. S. P. Spalding and Rear Adm. R. W. Paine, assisted by a staff of military and civilian personnel headed by Brig. Gen. Edgar P. Sorensen and Rear Adm. Thomas S. Combs.

Board's program is predicated on the theory that plans for industrial readiness will be formed jointly by industry, the services and other government departments, and that industry itself will carry out those plans, with the government exercising control only where voluntary action fails.

It is intended to keep current our catalog of resources and production facilities, insure adequacies by stockpiling or other means where those might be necessary and determine the limited zone where government action is required. It contemplates government action only after voluntary action has failed.

Industrial advisory groups are not to formulate government policy. That is in the province of the board. But they are to see that the point of view of management and labor are not lost sight of, point out unnecessary interference with normal peacetime activities and furnish means of obtaining cooperation of business and labor.

As needs change and as industry takes new strides, board's plans are to be revised and alterations made in the structure of its working committees and boards.

Several of the latter are of recent organization, with functions related directly to the oil industry.

Newest of these is the Joint Procurement Assignment Committee, established in April to investigate existing or potential duplications of procurement between the Army and Navy. Where appropriate, it recommends to the board the assignment of responsibility for purchase of specific items or classes of items to either the War Department (including the Army Air Forces) or the Navy Department. It also recommends appropriate standardization of items or classes of items between the Army and Navy. Its recommendations as to joint specifications are submitted simultaneously to the Army-Navy Joint Specifications Board.

Specification Board Activities

Activities of the specifications board, directed by a standing committee of ANMB known as the Army and Navy Joint Specifications Council, are the coordination and development of joint service specifications on items, materials, processes, and standards issued by the War and Navy Departments. Wherever possible, the specifications board will establish joint standards for capacity, dimensions and tests.

Recommendations to the Specifications Board or the Aeronautical Board on the development of new or the revision of existing packing and packaging specifications are made by the Joint Army and Navy Packaging Board, which resolves differences between the services to insure uniformity.

ANMB set up last December an Industrial Facilities Committee to advise it on all matters related to the establishment of such facilities for the peacetime Army and Navy and the nucleus for operation and expansion in case of a future emergency.

Committee makes recomendations on legislation required to put War or Navy Department or RFC-owned industrial facilities into the active or standby categories of the peacetime program, on the designation of industrial facilities that should be included in the program under War or Navy Department ownership, the selection of basic industries that should be included in the program, and the coordination required with civilian industry to supplement the program. Legislative proposals have been initiated for retention of plants in leased status.

A Strategic Materials Committee, ANMB, whose responsibility is stockpiling, does not directly concern itself with petroleum, but does list lead among the materials it recommends for classification, purchase and storage as strategic and critical. Petroleum, as it concerns the Army and Navy, is handled by ANPB which acts under the supervision of the ANMB.

The Strategic Materials Committee advises ANMB on all matters related to stockpiling in accordance with provisions of Public Law 117, and Surplus Property Act of 1944. In Congress now is a bill approved by Senate which would substitute a new stockpile board for ANMB as the stockpiling authority, but House has amended it to retain ANMB.

Storage of strategic and critical materials is the responsibility of still another group, the Stockpile Storage Committee.

Other committees of the board deal with lumber, procurement of medical and surgical equipment and supplies, requirements of basic and raw materials, components and end products, and the procurement and standardization of marine equipment and supplies.

South Carolina Jobbers Assn. Sends Out Jobber Questionnaire

Special to NPN

COLUMBIA, S. C.—South Carolina Oil Jobbers Assn. has approved questionnaire about jobbers "Home Town Activities" as used by Nebraska Petroleum Marketers for use by association. With a few changes, W. L. Heinz, secretary, will prepare a questionnaire and send to all independents in South Carolina, following similar action taken by other jobber associations (see NPN May 15, p. 20).

Copy of results obtained from questionnaire will be submitted to NPN.

Calendar of NLRB Cases Involving Oil Companies

NPN News Bureau

WASHINGTON — Developments for week ended May 31 in NLRB cases involving oil companies have been reported by the agency as follows:

Direction of Election

Standard Oil Co. (Ohio) (Case 9-R-2100), Cleveland—Election within 30 days of May 27. All garage employes in company's Cincinnati sales district, including the working foreman, but excluding clerical and supervisory employes, to determine whether they desire to be represented by Int'l Assn. of Machinists. Company contended bargaining unit should embrace all employes, except working foreman, in operations division of district other than clerical and supervisory employes—unit which would extend to about 110 employes, including various construction mechanics, laborers, retread mechanics, loaders, drivers, watchmen and dispatchers, while unit proposed by union comprises 12 employes. NLRB held that, despite occasional interchanges with employes in other groups, the garage employes have different duties and interests—in separate building—from those of other employes in division; union has not sought to organize other employes; working foreman is not a supervisory employe "within the meaning of our usual definition."

Certification

Standard Oil Co. (Ohio) (Case 8-R-2189), Lithograph Can Factory, Cleveland—Election held May 7. Certified (all production and maintenance employes except office, clerical, technical and supervisory employes): OWIU-CIO Local 395, which received 71 out of 76 valid votes cast.

WASHINGTON—By Herbert Yocom

The Reason for Excluding Oil From Proposed Stockpiling Act

WASHINGTON — A reading of Senate Banking Committee's 15-page decontrol amendment to OPA Extension Act leaves the single impression that this definitely is not the answer to the problem of freeing the petroleum industry from OPA control.

Mr. Yocom

The committee formula providing first for the filing of a petition with OPA and then, if OPA acts adversely, for the taking of an appeal to a special Price Decontrol Board, is so cumbersome that we doubt that it affords any promise of early relief whatsoever.

This being the case, it continues abundantly clear that the final fight on OPA must be made on the floor of the Senate itself. The hope is that body will have the good judgment at least to incorporate in the act some such language as that contained in the House-approved Gossett amendment, which provides for automatic decontrol of an industry whenever production equals or exceeds that of the last prewar year of 1941.

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There should be no serious cause for alarm in the fact that the House has seen fit to eliminate Senate language specifically excluding petroleum and its products from the proposed new stockpiling act. This is for the reason that the House would keep the Army-Navy Munitions Board as the dominant voice in the stockpiling picture, and that agency, as is well known, already is firmly on record:

1. That petroleum does not lend itself to stockpiling, and

2. That the best way to assure an adequate supply of critical items which cannot readily be stockpiled is through continuing contact with industry advisory committees so that important technological developments "can be readily applied to mobilization planning and needed facilities can be anticipated."

While the Senate bill has the obvious virtue of excluding petroleum in so many words, a disturbing feature is that it proposes to set up a new agency, to be known as the Strategic Materials Stock Piling Board. We say "disturbing" because new agencies in Washington usually have a way of reaching out for power, of coming up with strange ideas, one of which, in this particular instance, might be the notion that it was a mistake to exclude oil from the act and result in a drive on Congress to change the law.

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Having Harold L. Ickes as a friend can be pretty trying, too, as Ralph K. Davies probably is learning to his sorrow.

Not content with attempting to put in a good word for Davies at California Standard's recent stockholders meeting—an episode which prompted Davies to resign from the company—Ickes now has burst forth in his tri-weekly syndicated newspaper column with a pretty rough statement to the effect that Standard has handed the former Deputy PAW the old "double cross."

It's all very noble of Ickes, of course, to stand up for Davies, but somehow or other we just can't escape the feeling that he is doing irreparable damage to the Davies cause, and that Davies knows it, disapproves entirely of his infernal harping and wishes that he would be done with it, now and forever.

ATLANTIC COAST—By Frank P. S. Glassey

Gasoline Pump Supply Problem Similar to That in Other Industries

NEW YORK—Recent telegraphic correspondence (see NPN May 29, p. 14) between W. W. Heinz, secretary of the South Carolina Oil Jobbers Assn., and G. Denny Moore, managing director of the Gasoline Pump Manufacturers Assn., discussed a problem that exists in every segment of every industry, because of the general shortage of all types of equipment due to strikes and other reconversion difficulties.

Mr. Glassey

Mr. Heinz asserted that majors were being favored in pump deliveries. Mr. Moore replied that since pump manufacturing was resumed approximately 47% of all shipments went to independent marketers and that "generally shipments were in the same percentages to various purchasers which prevailed before the war." He added that output since the end of the war has been only 34,000, that present production is only about one-third of normal and that "strike handicaps and motor shortage offer little encouragement for improvement for several months."

Mr. Heinz said that he appreciated Mr. Moore's telegram but that he still believes "there is a possibility that independents are not getting their share of pumps." He noted that at a meeting of his association held on Memorial Day, the largest number of pumps any member reported receiving since the end of the war was 5, and the average was less than 2. Orders placed a year ago, Mr. Heinz said, have averaged less than 10% delivery.

"We realize there are difficulties in pump manufacture," Mr. Heinz added, "and we aren't bitter about it. But we know also that majors in our territory are getting deliveries, and getting them in large quantities."

To which Mr. Moore replied:

"The industry has more than 1000 salesmen who do nothing but solicit the independent jobber. The companies want to maintain that sales force, but they never could unless they got the independent business. They mean to see that the independent is treated fairly.

"Meanwhile the pump companies are losing an average of at least $40 on every pump being sold now, due to the high cost of material and labor. So far as any charge of discrimination is concerned, there is one manufacturer which has had on order more than 1000 pumps from a major oil company since V-J Day, and has been unable to make any deliveries."

Perhaps the best exposition of the pump manufacturers' position was made in a letter last week by one of the leading Fort Wayne companies which replied to a South Carolina jobber who had complained over non-delivery of pumps. The vice president and sales manager of the Fort Wayne company wrote, in part:

"We are allocating our production on a historical basis comprising the years 1939, 1940 and 1941. We have classified our customers into two categories: (1) independent oil jobbers and (2) major oil companies. We have determined our percentage of sales to these two customer classifications for the historical period 1939 to 1941 inclusive, and that is the basis on which we are allocating our shipments.

"The oil jobbers and major oil companies are both getting their respective percentage of our current production.

We have not deviated, nor do we intend to deviate, from this policy.

"It is possible that some of the major oil companies are receiving quantity shipments to certain distributing or warehousing points. The reason for this is that the major oil companies may elect to pool their allocation of pumps for a certain territory and have them shipped to one destination. This may create the impression that the major oil companies are receiving substantial shipments—but in reality when the pumps are distributed throughout that particular operating territory, the quantity does not exceed the shipments to independent jobbers.

"In other words, if we were to consolidate shipments to our independent oil jobber customers in South Carolina and ship them at one time in several carloads to one destination, it would result in a substantial shipment—but when distributed throughout the state to our various customers, it would not represent many pumps for any one individual."

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A week ago, in these pages, reference was made to a case in which a Mexican court was scheduled to rule on whether El Charro Co., originally promoted by Sinclair Oil Corp., would be entitled to adhere to its contract with the government and exploit its concession. It was noted that the decision might have a great effect on future U. S. oil policies in Mexico.

No decision has been handed down, and that is perhaps of even greater import than if the court had ruled either for or against the company. The tribunal in Tampico heard a preliminary statement of the case last week, concluded that the arguments against the concession were weak, and postponed further consideration of the matter until August.

The date of postponement is significant. The case will be heard next after the July elections, when a new administration, more friendly to American capital, is expected to be voted into office. Perhaps the Mexican courts will also heed the message of the ballot box, and perhaps also, by the end of the year, there may be gracious overtures from south of the border to U. S. oil companies.

MIDWEST—By Earl Lamm

Oil Company Buyers Would Simplify Industry Procurement Procedure

CHICAGO — Oil company buyers' group attending National Assn. of Purchasing Agents convention at Stevens hotel here May 27-29, adopted program looking toward improvement in petroleum industry procurement procedure with substantial reduction in paper work to cut red tape and operating expense. One estimate was that average purchasing department payroll expense is up about 20% over prewar, principally due to expeditor service, which it is desired to dispense with as loosening of supplies permits.

Mr. Lamm

Belief of the buyers is that they can contribute substantially to economies necessary during the future highly competitive business period, and are of the opinion on TBA and similar items, that "a thing properly bought is half sold." Quotation does not imply price cutting, but applies to exercise of proper procedure and fair prices on quantity purchases.

Some purchasing department heads are currently holding meetings with district and territorial oil marketing departments in the Midwest in developing coordinated programs. Suggestion is for minimum stocking of TBA, pumps, station signs and other marketing items as they become available compared to present hand-to-mouth buying. Attempts are being made to work out similar procedure for refinery and producing department warehouses. Caution is to be exercised against overstocking as guard against possible inventory losses such as occurred in depression following World War I.

At group meeting here May 28, deliveries of line pipe and other tubular goods, with single exception of still tubes, were reported slowed up 30 to 60 days by factory labor difficulties since Jan. 1. Line pipe and tubing below 3-in. and 4-in. sizes are especially short. Surplus of still tubes, including alloy tubes, was reported. Most buyers are now looking 3 to 6 months ahead, compared to deliveries within 60 to 90 days following World War I. All orders for line pipe and other heavy goods were reported as having been placed for the third quarter of 1946, plus many orders for the fourth quarter, with some extending over into 1947. Metal for petroleum containers will be short until food packing season is over by end of September, it was said.

Pipe manufacturers present declared there was little use to place orders for shipment more than six months in advance, since nothing can be done about them and changes likely will create added work of revisions.

Purchasers expressed belief that there is little if any duplication of orders among large oil company buyers, but private opinion is that some duplication exists among pipe jobbers and other middle men, whose success depends largely upon their ability to fill orders. Consensus appears to be that once labor is satisfied, volume production will develop rapidly. Speakers in general sessions of the convention, which includes various industries in addition to oil, criticized OPA severely.

In the simplified buying program tentatively advocated by the oil group at the convention, hope is for reduction of about 20% in paper work this year from an estimated total of 71 million pieces of paper annually involved in oil industry purchases, including material bought for export. Buyers point out that some employe must handle each of the 71 million pieces of paper and 20% reduction would mean substantial saving, not only in clerical work but in waiting time of truck spent on too frequent trips to sellers' warehouses.

Subcommittee is to be appointed later for "guinea pig" test of improved procedure in some local area, probably in the Southwest, after methods now employed by various companies in that area are surveyed, studied and improved procedure more fully worked out.

R. M. Morrison, general purchasing agent for The Texas Co., New York, was re-elected chairman of the National Assn.'s oil group, which has total membership of 221. Owen D. Story, Shell Oil, Houston, was named vice chairman. Combined annual purchases of the group is said to total in excess of one billion dollars.

Name Vice President

NPN News Bureau

CHICAGO — Ira C. Jared, Sun Oil Co., Dallas, was elected a vice president of National Assn. of Purchasing Agents at the association's annual convention here May 26-28.

He succeeds O. D. Story of Shell at Houston, and this year will represent the oil industry buyers' group in the national organization, which includes purchasers from various industries. About 2400 attended the convention held at the Stevens Hotel here. George W. Aljian, director of purchases and packaging for the California & Hawaiian Sugar Refining Corp., Ltd., San Francisco, was elected president of the association.

Davis Is Scheduled To Talk on OGD At A-NPB Seminar

NPN News Bureau

WASHINGTON — Relationship of Interior Department's new Oil and Gas Division to A-NPB, other government agencies and industry will be discussed by R. K. Davies, acting director of OGD, during opening session of seminar which A-NPB will hold here June 13 and 14 for industry men formerly in Army and Navy petroleum activities.

Early opening hour of 9:30 a. m. has been set in view of a packed agenda. This includes visit to nearby Annapolis, Md., for synthetics demonstrations by Navy and POL show by Army Quartermaster Fuels and Lubricants Branch on first day, and second general session on 14th to be followed by group discussions touching on work of all six A-NPB divisions.

Dr. W. C. Schroeder, director of Bureau of Mines' synthetic liquid fuels research program, is headline speaker for second day's general session.

Among group discussion topics listed by Supply, Fiscal and Accounts and Technical Divisions are the following:

Supply Division

1. Third and fourth quarter requirements and industry circumstances with respect to meeting them.
2. Reaction of industry toward nationwide contracts vs. regional contracts, particularly as regards lube oils.
3. Packaged products outlook.
4. Possibility of obtaining accurate reports of inventory of military aviation stocks at refineries.
5. Possibility of commingling Army Air Forces and commercial aviation fuel stocks at f.o.b. delivery points.
6. Production possibilities to jet propulsion fuels, particularly on East Coast, in event that Navy and AAF overseas requirements increase materially.
7. Information from industry on location and quantities of commercial stocks of aviation fuels and lubes at commercial airports and bulk plants, and refineries actively producing those products; no purchases of Grade 91 fuel to be made until government-owned stocks are depleted.

Fiscal and Accounts Division

1. Why are oil companies' f.o.b. refinery prices higher than military's; are company prices same for Navy Special, Diesel, mogas, etc., throughout Persian Gulf, i.e., Bahrein, Ras Tanura, Abadan?
2. How do companies calculate overhead element to be included in CIF cost?
3. Filling charges—what is general rate used for this process?
4. Spread of drum costs.
5. Costing rates for leakage and evaporation.
6. Handling charges — do companies have specific rates for different products?
7. Tanker delivery charge practices.
8. Practices in calculating dry cargo freight.
9. Any available data on various types and sizes of packages for products.

Technical Division

1. Specifications—Army, Navy, joint service (JAN) and federal specifications and those of working committee of the Aeronautical Board (AN).
2. Difficulties with motor gasoline with respect to induction gum deposits and valve trouble.
3. Test methods to predict stability life of aviation gasoline in storage.
4. Means of making technical data developed by companies available to A-NPB.
5. Standardization of test methods.
6. POL laboratory control in war theaters.
7. Lubricants, greases, etc.

OPA Gives Pump Manufacturers Temporary Ceiling Price Raise

NPN News Bureau

WASHINGTON—OPA on June 4 gave manufacturers of power-operated pumps, including gasoline pumps, a further temporary increase of 15% over base ceiling prices, effective June 5.

Increase applied when the pumps are sold with power units. When sold without power unit, allowable increase is only 8%. Increases are intended to cover increased costs to manufacturers.

Union Says Maritime Strike Would Not Affect Tankers

NPN News Bureau

NEW YORK—If National Maritime strike is called June 15, tankers "will not be affected," Office of National Maritime Union told NPN June 3.

Previously Joseph Curran, president of union, had been credited with statement only "dry-cargo vessels" would be struck. This was first direct indication from union representative, however, that tankers would not be included in strike call.

Truman Transfers Hot Oil Act Duties to Oil and Gas Division

NPN News Bureau

WASHINGTON — President Truman has issued executive order (No. 9732) transferring administration of Connally Hot Oil Act from Petroleum Conservation Division to Interior Department's new Oil and Gas Division.

Action completes formal liquidation of PCD, all of whose employes will carry on activities hereafter as part of OGD's conservation and reserves branch. Under a delegation from acting OGD director Davies, job of administering Connally Act will continue to be exercised for time being by E. B. Swanson, formerly acting director of PCD.

Toledo Refinery Still Idle

Special to NPN

TOLEDO, O. — Pure Oil Refinery, closed since May 20 by a strike of OWIU workers, remained idle this week. Company officials said no meetings have been held during past week and indications are settlement is not yet in sight.

Senate Floor Trade May Take Oil Out of OPA's Jurisdiction

NPN News Bureau

WASHINGTON — Fate of OPA became increasingly uncertain this week as the threat of a presidential veto failed to curb further changes and submission of proposed amendments to legislation extending the agency's life beyond June 30.

Political considerations appeared to be the only item in the way of suspension of oil price ceilings by OPA itself, and indications were growing that amendments specifically exempting petroleum from price control would be offered when the extension bill moves to the Senate floor next week from the Banking and Currency Committee.

No proposals to exempt petroleum specifically have been offered in committee sessions, but the large number of pet amendments which individual senators will attempt to have passed on floor point to possibility of trade whereby support for an oil exemption amendment might be obtained in exchange for votes for a reasonable profit provision or other consideration.

Pressure for immediate suspension of oil price controls was brought to bear on OPA Chief Porter last week at conference with House Speaker Rayburn (D., Tex.), Chairman Patman (D., Tex.) of House Small Business Committee; Rep. Johnson (D., Tex.), Former Gov. James V. Allred of Texas, and Elmer Patman, cousin of Rep. Patman and Attorney for Superior Oil Co., Houston.

Political Angle Considered

Porter seemed to have gotten the upper hand, however, for he crowded the Texans into conceding that it would be politically unwise to decontrol oil or any other maior industry while OPA extension legislation still was before Congress, lest it lead to impression that agency was trying to make deals with the legislators in eleventh-hour effort to save OPA's life.

Porter did take this one positive step, however; he requested OPA fuel price division to speed its report on decontrol recommendations. Illness of J. H. Reppert, acting director of division, has delayed the report, but staff now is reconciling difference of opinion and some report is expected to go to Deputy Administrator Geoffrey Baker before end of week.

Inland 'Special' Diesel Sources Will Be Dropped by the Navy

NPN News Bureau

WASHINGTON—Navy does not intend to buy any more Navy special fuel oil or 7-O-2-d Diesel from inland sources after present contracts expire. Most of these run out June 30.

Supplies at seaboard are expected to be ample, and Navy would save freight costs.

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Predict Plentiful Supply of LPG Equipment Late in '46 or Early '47; See New Markets

Special to NPN

COLORADO SPRINGS, Colo. — Plentiful new equipment this year or early 1947, development of new markets, a consumer advertising campaign to protect markets of tomorrow, a safety campaign and an aggressive membership drive were the highlights of the first postwar annual meeting and industry exhibit of Liquefied Petroleum Gas Assn. at the Antlers Hotel here May 27-29. About 500 attended and there were 36 exhibits.

Technical developments are being studied and an industry manual is due for publication in about 30 days. It is being prepared by Franklin R. Fetherstone, vice president of the technical division.

In discussing new equipment in "Selling in a Seller's Market," John K. Knighton, manager of sales for Servel, Inc., Evansville, Ind., declared that production and delivery are very real current problems, and that sales and sales organizations are problems of tomorrow.

"But that 'tomorrow'," he continued, "is just one minute past midnight of any day—any week—any month—and certainly in this year or early '47, when you will have more appliances and equipment than you have known and qualified prospects. The transition from a seller's market to a buyer's market will be quick," he said. "It will be local before it becomes national, and distributors and dealers will be the first to feel its effects."

Citing present production difficulties, he said Servel does business with 900 suppliers, 450 of whom furnish raw material, and that all of them have problems identical with those of Servel insofar as supplies; machine tools and dies; the attitude, efficiency and training of labor; manufacturing facilities and government regulations—particularly OPA—are concerned.

See New Summer Uses

Regarding new markets, R. W. Thomas presented a paper prepared by himself and G. G. Oberfell, both of Phillips Petroleum Co., stating that present and potential supplies of LPG far exceed present demands. They pointed out that leveling off of the winter-summer demand ratio is possible by development of new summer uses.

"Possibility of increased summer uses," they said, "include flame cultivation, weed burning, farm produce dehydration and motor fuel used in farm tractors and irrigation power units.

"Flame cultivation of cotton, sugar cane and other row crops will consume a large volume of propane and butane in 1946," they continued, "and will expand many times in 1947-48."

Four other points made in the address were: (1) the industry's initial rapid growth has been followed by war years of very healthful consolidation; (2) growth of the industry, particularly for domestic use in 1947-48, should far exceed any previous two-year period; (3) there are ample supplies of butane and propane for requirements of motor fuel, aviation gasoline, synthetic rubber and the chemical and LPG industries; (4) but increased cost of production facilities and increased competition from other industries probably will, in time, increase the cost of propane—and certainly will increase the cost of butane—to the LPG industry.

Cites LPG Use in Gas Engines

Possibilities for new and expanding markets for butane and propane in gas engines used in irrigation pumping, in western areas of the United States particularly, were elaborated upon by C. M. Denton, chief engineer for Pacific Tank Co. He cited an instance of 170 customers with 260 such engines having a combined 19,500 h.p. which, in the one area, represented 30% of the total industrial load devoted to irrigation pumping.

He suggested development of this new field by working with pump manufacturers and well drillers. Butane and propane pumps, he declared, have the advantage of extreme flexibility.

"In no other type of pump power," he said, "particularly electrical power, can variable speed operation be successfully used with any kind of economy whatever. With internal combustion engines and good pump characteristics, a uniform delivery at variable speeds and at variable water levels with extreme safety to the well, can be accomplished."

Other speakers on the program were L. H. Selz, Selz Organization, Chicago, who discussed association publicity; H. Emerson Thomas, Fuelite Natural Gas Co., and Clarence Cooper; Elmer Cone, western representative of Ruud Mfg. Co., talked on water heating with LPG, and K. R. D. Wolfe of Fisher Governor Co., on equipment maintenance.

Mr. Wolfe recommended a study on the causes of internal corrosion of copper tubing pigtail connections between cylinder and regulator assembly, which has given difficulty. One case discovered, he said, is so serious that replacement of 50,000 copper tube pigtails is being considered.

In a discussion of "Safety and Insurance," Mr. Thomas suggested appointment of an insurance committee, or representative, for the industry, with a subcommittee in certain areas, like Texas and Louisiana. Higher insurance rates and new classifications issued by National Bureau of Casualty & Surety Underwriters, effective April 18, may influence additional companies in the writing of coverage for LPG operators, he said.

LPGA Elects C. O. Russell

Special to NPN

COLORADO SPRINGS, Colo.—New officers elected by Liquefied Petroleum Gas Assn. at convention here May 27-29 were:

President, Charles O. Russell, president of Thermogas Co., Des Moines, Ia.; executive vice president, Howard D. White, Chicago; first vice president, L. V. Rothrock, Twin Falls, Idaho; second vice president, Wendell B. Wight, Albany, Ga. Other vice presidents: Tallant H. Ransome, Emeryville, Calif.; Foster V. Maybee, Denver, and Walter A. Maumer, New York. Arthur C. Kreutzer was named secretary and assistant treasurer, and Budd D. Geroy, treasurer, both from Chicago. Franklin R. Fetherstone, New York, an engineer who has been with the association for a number of years, was advanced from secretary to vice president of the technical division.

Cleveland Petroleum Club To Hear Ethyl Research Man

NPN News Bureau

CLEVELAND—Dr. George Calingaert, director of chemical research for the Ethyl Corp. will be guest speaker at the June 10 meeting of the Petroleum Club of the Cleveland Chamber of Commerce, at the American Room of the Mid-Day Club.

Dr. Calingaert's subject will be "The Oil Battle on the German Front." It will be illustrated with pictures taken in connection with a mission by Dr. Calingaert to the European theater of operations to assist in the United States Strategic Bombing Survey on the effect of bombing German industry.

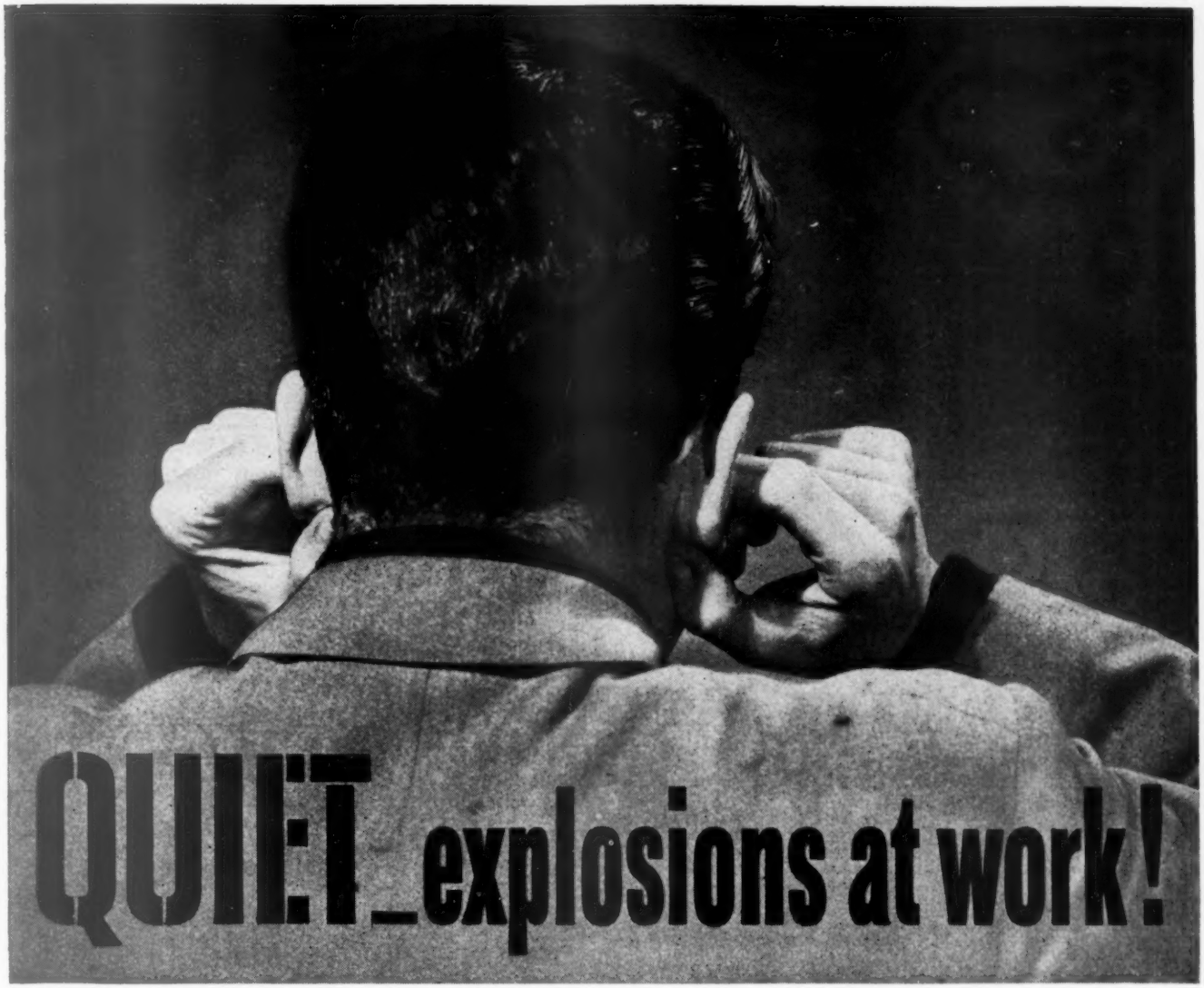
Tentative Witness List Set By FPC in Gas Investigation

NPN News Bureau

WASHINGTON—FPC has announced following tentative list of participants in final hearing June 17 here in natural gas investigation:

New York Public Service Commission, Kansas Corporation Commission, Owens-Illinois Glass Co., Bureau of Mines and Geological Survey, Hydrocarbons Research Inc., Manufacturing Chemist Assn., Koppers Co., and Eastern Gas and Fuel Associates, California Railroad Commission, Illinois Bituminous Coal Producers, Coal Trade Assn., of Indiana, National Coal Assn., United Mine Workers, Railway Labor Executives Assn., Anthracite Institute, AAR Western Assn., of Railway Executives, Maher Coal Bureau, Lake Michigan Docks Assn., Natural Gas Industry Committee, and IPAA.

FPC said it expected other companies and associations to make appearances at hearing, including probably API, but above named are all who have notified commission thus far they intend to appear.



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QUIET—but exciting moments like these—moments spent taking the noise out of explosions, putting more power behind your accelerator—are typical scenes in Cities Service laboratories across the nation. There, exhaustive studies are continuously being made to provide better and better gasolene and fuel products.

In 1929, Cities Service developed and patented the famous Power Prover—a device through which you can gauge the real efficiency of an engine by measuring the unburned oxygen and other components in the exhaust gases. Later, Cities Service applied the Power Prover technique to aviation problems—as a result these instruments became invaluable to us in the war.

To date Cities Service scientists have developed gasolene fuels that are so high in octane count automobile engines *still* have to be radically redesigned to take full advantage of them. And so it goes—the gasolene advances of today are waiting for the car of tomorrow... Yes, you can look to Cities Service for important new developments where petroleum is concerned.

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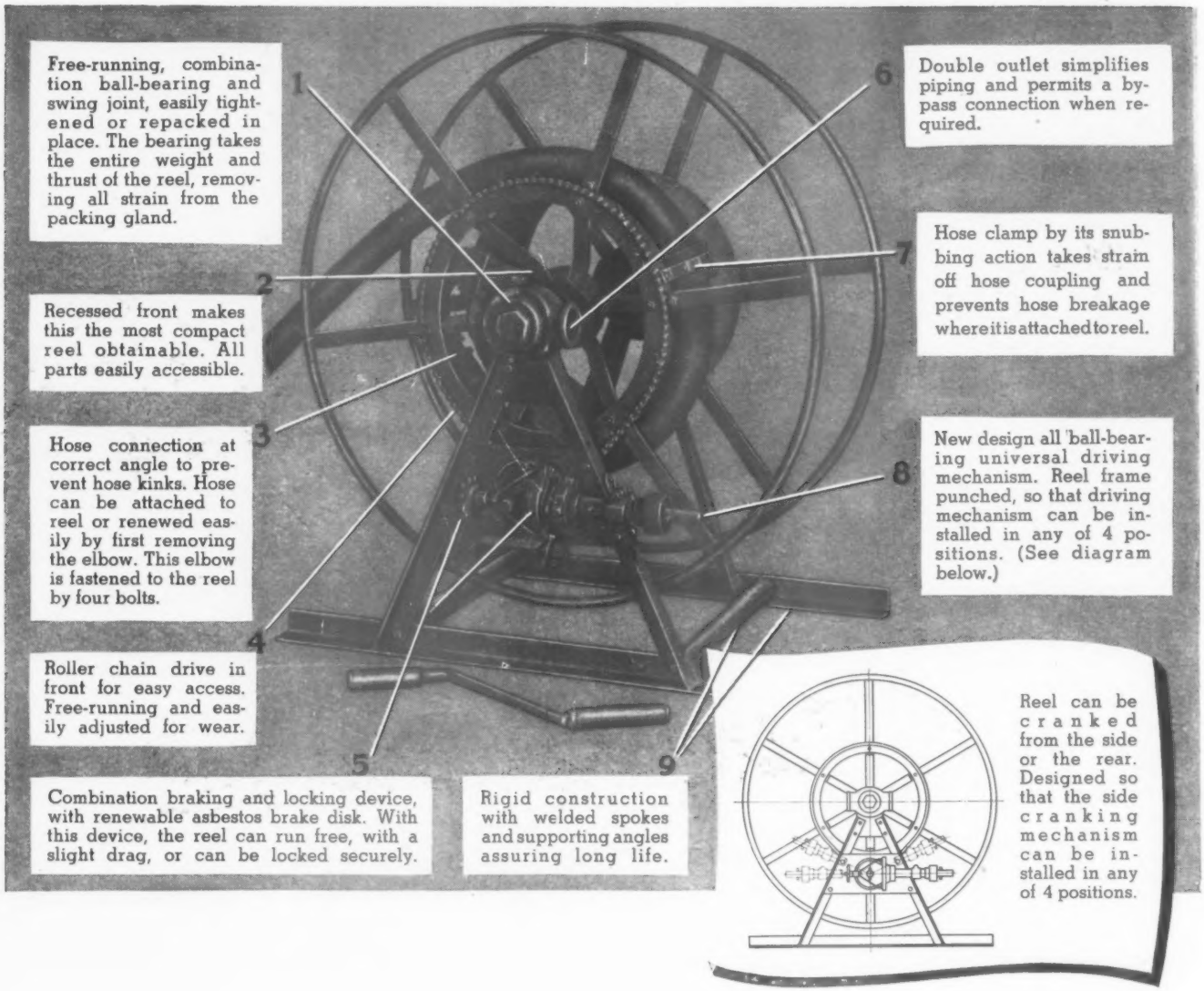
1
Free-running, combination ball-bearing and swing joint, easily tightened or repacked in place. The bearing takes the entire weight and thrust of the reel, removing all strain from the packing gland.
2
Recessed front makes this the most compact reel obtainable. All parts easily accessible.
3
Hose connection at correct angle to prevent hose kinks. Hose can be attached to reel or renewed easily by first removing the elbow. This elbow is fastened to the reel by four bolts.
4
Roller chain drive in front for easy access. Free-running and easily adjusted for wear.
5
Combination braking and locking device, with renewable asbestos brake disk. With this device, the reel can run free, with a slight drag, or can be locked securely.
9
Rigid construction with welded spokes and supporting angles assuring long life.
6
Double outlet simplifies piping and permits a by-pass connection when required.
7
Hose clamp by its snubbing action takes strain off hose coupling and prevents hose breakage where it is attached to reel.
8
New design all ball-bearing universal driving mechanism. Reel frame punched, so that driving mechanism can be installed in any of 4 positions. (See diagram below.)
Reel can be cranked from the side or the rear. Designed so that the side cranking mechanism can be installed in any of 4 positions.

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The reel can be changed from top winding to bottom winding by reversing the hose connection and rotating the drum. All working parts and hose connections are in front and easily accessible. It is light in weight, a reel that holds 100 feet of 1½" hose, weighs only 93 pounds.

We can furnish hose reels in any size or shape. They can be furnished for installation either in bucket box at rear of truck or in underslung box on side of truck. Give inside dimensions of box when writing for information. Special reels can also be furnished for Airfield Refueling Pits and Ship Docks.

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Design Change May Result From Higher Antiknock Fuels Available Then

Special to NPN

FRENCH LICK, Ind.—Changes in automobile engine design by 1950 to take advantage of the higher quality motor fuels which will be generally available then, were discussed by Earl Bartholomew, general manager of research laboratories, Ethyl Corp., before the summer meeting of Society of Automotive Engineers here June 2-7. Improvements in both fuel economy and power output can be obtained, he stated, whether by the use of superchargers or higher compression ratios.

Mr. Bartholomew

"Dimensions and weights of parts, and of the powerplant as a whole, depend on the choice of construction materials and of fuels", he said. "In turn the selection of materials is governed to a large extent by the chemical reactions of the fuels and lubricants under the conditions of operation which they make possible.

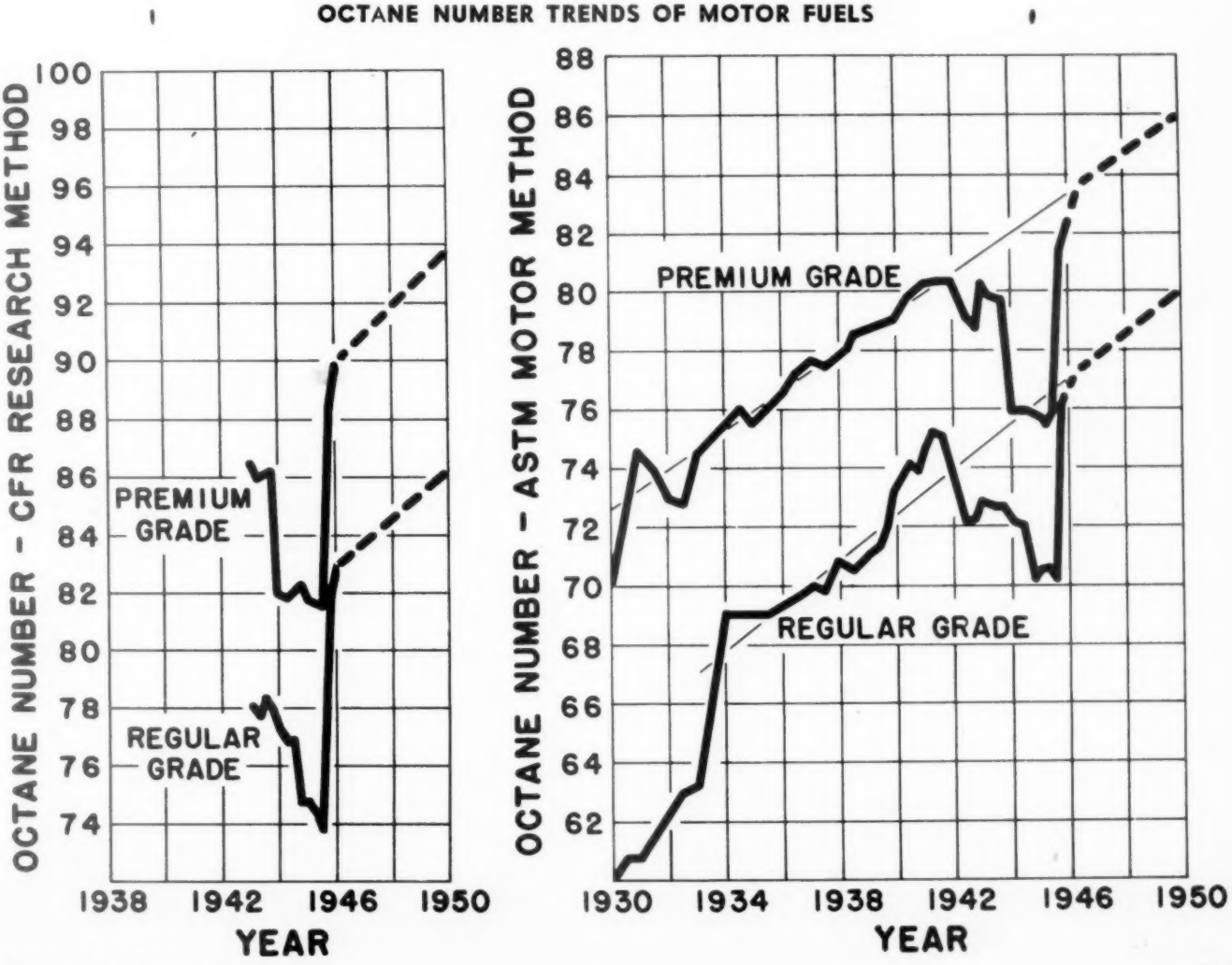
"Finally, the problem of the oil refiner is one of tailoring fuels and lubricants, within the limits of the technology of the moment, to the ever-changing requirements of progressively better engines. The fundamental problem is the same, whether the engine be of the Otto, Diesel or turbine-jet type. The future of each is tied to the characteristics of fuels which will be available."

Mr. Bartholomew's study of coming engine design was based on his estimate that, at the begining of 1950, premium and regular grades of motor gasoline would have average ASTM Motor Method octane numbers of 86 and 80 respectively. Research Motor Method ratings, more satisfactory than Motor in correlating with road performance, it is estimated would rate 93.5 for premium and 86.0 for regular by 1950. The conservatism of these estimates is indicated, it is said, by the fact that the maximum quality of commercial motor gasoline sold in February, 1946, was 95.4 and of regular 89.6 Research Motor Method, thus more than meeting estimates for 1950.

Ethyl Corp. laboratories, by a combination of experiment and the application of basic thermodynamic principles, studied possible improvements in engine design resulting from these higher antiknock fuels.

It was recognized that extensive use of newly developed refining processes tends to increase concentration of certain types of hydrocarbons in commercial motor gasolines. Gasolines refined by different processes or from different crude stocks, although having the same octane number as determined by conventional methods, may vary considerably with respect to knock-limited performance in automobiles. In surveying the power and economy possibilities of the new fuels it was necessary to investigate the magnitude of this variable in knock-limited performance.

Four gasolines, each having a Motor Method octane number close to 80 and containing more than 50% of one of the common classes of hydrocarbons—paraffins, naphthenes, aromatics and olefins—



were run in a test engine at knock-limited intake manifold pressure over a wide range of compression ratios at speeds from 600 to 2500 R.P.M. The tests were both with and without 3cc of tetraethyl lead. These four base fuels were said to be representative of stocks which refiners might use in varying proportions in the production of motor gasolines. "They served to indicate the variations in fuel behavior which will confront the engine designer", said Mr. Bartholomew.

The relationship between the three variables, maximum compression pressure, manifold pressure and engine speed was charted for the four fuels. For the highly paraffinic fuel, as would be expected, the permissible manifold pressure at any particular engine speed decreased as the compression ratio was increased. As engine speed was increased, higher manifold pressure and compression ratio could be used. When tetraethyl lead was added, the general relationships between the three variables remained essentially unchanged but the levels of permissible compression ratio and manifold pressure were materially raised. For the highly naphthenic fuel the general pattern was the same.

Fails to Meet High Speed Performance

Test data when the highly aromatic fuel was used showed that higher compression ratios may be used than with the paraffinic fuels, particularly at low speed and high manifold pressure. For the highly olefinic fuel also relatively higher compression ratios may be employed at low speed and high manifold pressure, but this fuel requires a considerable lowering of compression ratio as engine speed is increased. A highly olefinic fuel having the same critical compression ratio as the highly paraffinic fuel at low engine speed may fail to meet the high speed performance of the latter by as much as 1.5 compression ratios, it was brought out.

"In the multicylinder passenger car engine a further complication is introduced at low engine speed by equal distribution of unvaporized heavy end of fuels to the different cylinders", said Mr. Bartholomew. "As a consequence, the fuels which give best low-speed performance are those having in their more volatile fractions the maximum concentration of high antiknock hydrocarbons possessing relatively good low speed quality.

"Thus, of two fuels having the same Motor Method knock rating, one having a large proportion of high antiknock aromatics and olefins in the volatile fractions with relatively low antiknock paraffins in the heavy ends, gives better low speed performance than one having low antiknock paraffins in the volatile fractions with a considerable concentration of olefins in the heavy ends. The problem is somewhat further complicated by variations in sensitivity to tetraethyl lead of the fuel fractions entering the different cylinders at high and low engine speeds.

"It is apparent from the foregoing that the designer of engines for the new fuel must reckon with more than Motor and Research Method octane numbers. He must necessarily understand the potentialities of the different types of fuels in respect to compression, volumetric efficiency and speed; also have knowledge of the volume in which the different types of fuel are likely to be produced. There will be no satisfactory substitute for actual tests of representative fuels in experimental engines during the development stage.

"Likewise the fuel refiner should understand these engine-fuel relationships in order that he may, to the extent economically feasible, adjust fuel composition to the trends of engine dictated by transportation requirements. The problem calls for the closest possible co-operation between the technologists of the oil and automotive industries."

It was prohibitive in the Ethyl Corp.'s test program to build experimental engines to be installed in cars to test all possible combinations of manifold pressure and compression ratio. So a procedure was worked out for estimation of the overall percentage improvement in level road car performance and economy obtainable from any given change in the compression ratio or manifold pressure of the engine, or from any modification of transmission characteristics or axle ratio. Controlled fuel economy and acceleration tests were also carried out in test engines to compare predicted with observed results.

From these studies it was concluded that, in conjunction with fuels of improved antiknock quality, either higher compression or increase in manifold pressure may be employed to provide either a substantial increase in vehicle performance or fuel economy or a smaller simultaneous increase in both.

High Compression Engines

Problems in engine design arising from the application of high compression ratios to take advantage of the improved fuels were presented in Mr. Bartholomew's paper.

"The attractive advantages of high compression engines requiring fuels of 90 to 95 octane number on the road are accompanied by a number of formidable but apparently not insuperable problems of design," he stated. "At a compression ratio of 8.5 explosion pressures are of the order of 1000 pounds per square inch, compared to about 600 pounds at a compression ratio of 6.0."

"From the standpoint of structural rigidity, the compact short engine would appear to have an advantage over the in-line type, hence it is to be expected that a considerable amount of effort will be devoted to the development of vee and opposed designs. The increased torque due to high compression will permit a reduction in engine displacement for a given power requirement but, in view of the greater structural rigidity required, it seems unlikely that, for the same power output, high compression engines designed to use the high octane fuels will weigh any less than current engines. It is believed, however, that at the same weight they can be made to have equal smoothness."

"In any planning for the utilization of improved fuels over a period of years, through increase in compression ratio, it seems logical to design a basic engine having sufficient structural rigidity for fuels of 95 to 100 octane number on the road. Compression ratio could then be increased in a series of steps from present levels with a minimum amount of redesign."

As compression ratios are increased beyond present values, clearance volumes in combustion chambers become smaller requiring care in the design of combustion chambers, particularly in L-head engines, to prevent loss of volumetric efficiency, it was brought out. Overhead and sleeve-valve engines, with their more compact combustion chambers, present less of a problem in this respect, it was stated.

Supercharging

Supercharging was discussed as another means besides higher compression ratios for providing increased power output with high antiknock fuels.

It was indicated in the test work that power output at any particular compression ratio is substantially proportional to charge density in the manifold and specific fuel consumption is practically constant. "Thus it would appear," said Mr. Bartholomew, "that supercharging offers a means of utilization of improved fuel antiknock values for the production of a large amount of power from a relatively small displacement but without improvement in fuel economy."

"A small supercharged automobile engine," he said, "having substantially constant specific brake fuel consumption, over the range of manifold pressure above atmospheric, appears to offer interesting possibilities from the standpoint of fuel economy.

"On the basis of experimental results, it is believed that the small boosted engine could be operated at an absolute manifold pressure of at least 40 in. Hg., possibly 45 in., at 6.1 compression ratio and maximum power spark advance on fuels having a road octane number of 95. The calculations indicate that, on the basis of 40 in. or 45 in. manifold pressure, the displacement could be reduced to about 74% or 66% respectively of that of a naturally-aspirated engine having the same compression ratio if the previously assumed 4.4 rear axle is retained."

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Warren Petroleum's Purchase of Hanlon Companies Combines Two Leaders in Natural Gasoline Industry

In the old days this was a full day's output of the Hanlon plant. Six iron barrels of natural gasoline were transported by ox team to an Ohio river landing

By Earl Lamm
NPN Staff Writer

TULSA—The natural gasoline industry has its eyes on the future, and no company in it is looking forward with greater confidence than is Warren Petroleum Corp.

When on May 1 Warren purchased the Hanlon-Buchanan properties, it strengthened its hold on world leadership in the manufacture and sale of natural gasoline and liquefied petroleum products for the open spot market. The purchase brought under single ownership two companies developed by men who helped transform natural gasoline from an erratic 10,000,000-barrel-a-year industry in 1921 into a 111,000,000 barrel-a-year industry which makes ever more valuable products from resources that otherwise might be wasted.

To know these companies, to comprehend their contributions to the industry and to understand their success, it is necessary to know the men who built them—W. K. Warren, Edward I. Hanlon, D. E. Buchanan, Joseph A. LaFortune, Howard E. Felt—and the Hanlon-Buchanan executives who are continuing with the expanded company—J. H. Boyle, Ray E. Miller, James E. Allison.

W. K. Warren, who organized the predecessor companies of the Warren Petroleum Corp. in 1922, is a builder of markets. He has been instrumental in stimulating sales and distribution of natural gasoline and liquefied petroleum products.

It isn't that Bill Warren has played the role of super-salesman or that he personally has found new uses for natural gasoline. It is rather that he has been an organizing force, a driving rod behind the extension of the use of natural gasoline.

Under Mr. Warren's direction, Warren Petroleum bought extensive storage so products made in spring and summer when the demand is slight, could be held until fall and winter when demand is heavy. These storage facilities helped stabilize the natural gasoline industry, permitting year-around operations of plants assuring customers of reliable supply during the winter and applying at least a moderate brake on price decreases in the summer.

The company entered the manufacturing business in 1934 and the following year purchased for $300,000 the entire natural gasoline department of Amerada Petroleum Co. From 1934 to the present time Warren Petroleum has averaged a plant a year.

Bill Warren is the type of man who

1945 Operational Statistics of the Companies

	Warren Petroleum Corporation	Hanlon-Buchanan Companies	Total
Shipments of natural gasoline and liquefied petroleum products in 1945	535,000,000 gals.	250,000,000 gals.	785,000,000 gals.
Natural gasoline manufactured in 1945	43,564,000 gals.	73,000,000 gals.	165,170,000 gals.
LPG manufactured in 1945	48,606,000 gals.		
Number of plants	12	4	16
Capacity of plants in gallons daily (including plant being built)	518,000 gals.	285,000 gals.	803,000 gals.
Tidewater storage (including tanks under construction)	702,500 bbls.	240,000 bbls.	942,500 bbls.
Number of tank cars	544	150	694
Crude production	500 b/d	3500 b/d	4000 b/d
Number of employes	500	300	800

Location of plants and daily capacity in gallons—Graham, Okla., 15,000; Maud, Okla., 30,000; Monument, N. Mex., 45,000; Fairbanks, Okla., 25,000; Salem, Ill., 100,000; Madill, Okla., 40,000; Crossville, Ill. and Griffin, Ind., 100,000; Holiday, Tex., 53,000; Gladewater, Tex., 175,000; Breckenridge, Tex., 50,000; McLean, Tex., 40,000; Sinton, Tex., 20,000; Fittstown, Okla., 25,000; Stroud, Okla., 5,000; Hawkins, Tex., 80,000. (Notes—Holiday plant under construction; Gladewater, Breckenridge, McLean and Sinton acquired from Hanlon-Buchanan; Fittstown and Stroud ownership shared equally with J. E. Crosbie, Inc.; Hawkins ownership shared equally with Humble Oil and Refining Co.)

Location of tidewater storage and capacity in barrels—Port Arthur, Tex., 210,000; Corpus Christi, Tex., 160,000; Houston, 292,500; Lake Charles, La., 100,000; Marcus Hook, Pa., 80,000; Baytown, Tex., 100,000. (Note—All built by Warren except 140,000 of the 160,000 capacity at Corpus Christi and four tanks leased from Humble at Baytown.)

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ment troops ... within 90 miles of Mukden, vital rail center in the battle for Manchuria.

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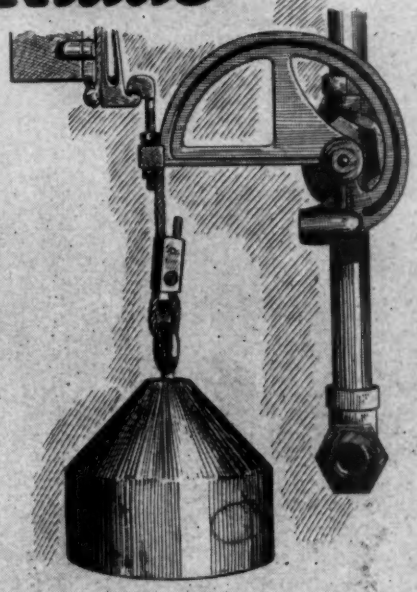

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Meat May Become

... stationed in a little town in France for several months, wooed a French girl by telling her about ... the ... into ...

Mr. Warren

Mr. Hanlon

makes a company and an industry "tick." He has a venturesome spirit and has the uncanny ability to make what at first appears to be a risky plunge come out right and pay off for his company and for the industry.

One official of Warren Petroleum says the company grew "because we all work like hell—and keep our word." That phrase fits Bill Warren perfectly. He frequently arrives at the office at 7 a.m., cleans up his paper work and is ready for a business trip by the time the office opens.

Mr. Warren was born in Nashville, Tenn. and grew up there. He came to the Midcontinent in 1916, and his first job was with the old Gypsy Oil Co. (Gulf) in Tulsa as a voucher clerk. A year and a half later he went to Margay Oil Corp., then to Gilliland Oil Co. in Shreveport in 1919. There he worked on natural gasoline, oil and pipeline records. He later was transferred back to Tulsa as assistant to Patrick J. Hurley, vice president of Gilliland.

In 1921 Gilliland sold its properties at Burkburnett to McMan Oil and Gas Co. Mr. Warren went with McMan, but he had acquired an interest in a small natural gasoline plant at Drumright, Okla. That was the turning point.

On Mar. 15, 1922, he organized his own company to market natural gasoline. His partner was the late Charles E. Brown, who had been head of the natural gasoline department of Twin States Oil Co. Mrs. Warren was the receptionist. Thus was the modest beginning of the company which today stands with Phillips, Lone Star Gas Co., Sinclair and Shell as one of the five leading companies in the natural gasoline industry.

Mr. Warren is a member of the board of trustees of the University of Tulsa and of Casia Hall, a boys preparatory school. He is a past president of the Tulsa Club, a director of API and is a member of Southern Hills Country Club, the Crozier Club, Mid-Continent Oil and Gas Assn. and the Natural Gasoline Assn. of America. He also is a member of Christ the King Church and in 1937 was invested with the Grand Cross of the Order of The Knights of the Holy Sepulchre.

Mr. and Mrs. Warren have seven children—one son, W. K. Warren, Jr.; six daughters, Mrs. John J. King, Natalie, Marilyn, Patricia Ann, Elizabeth and Jean Marie.

First vapor test made in Pennsylvania

Hanlon Award Donor

Ed I. Hanlon, one of natural gasoline's pioneers, is the donor of the Hanlon Award for meritorious service to the natural gasoline industry.

The award, sponsored by the Natural Gasoline Assn. of America, is recognized as a stimulant for achievement of benefit to the entire industry. The winner each year receives an engraved solid gold watch and memento chain and his name is engraved on a bronze plaque which hangs in the offices of the association. Although Mr. Hanlon has disposed of most of his natural gasoline property, he plans to continue the annual awards.

Mr. Hanlon has been in the natural gasoline business almost from the beginning.

The origin of natural gasoline, as the industry now regards it, is obscure — the current API Quarterly credits William Fasenmeyer with constructing in 1903 the first crude machine for production of natural gasoline. Mr. Fasenmeyer was soon joined by Sutton Bros.

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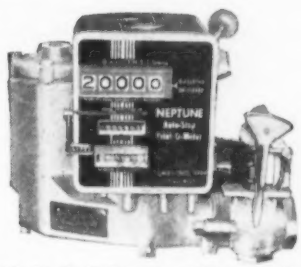

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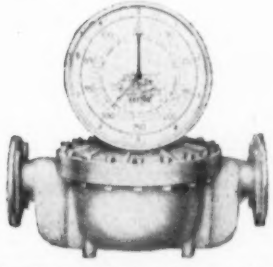

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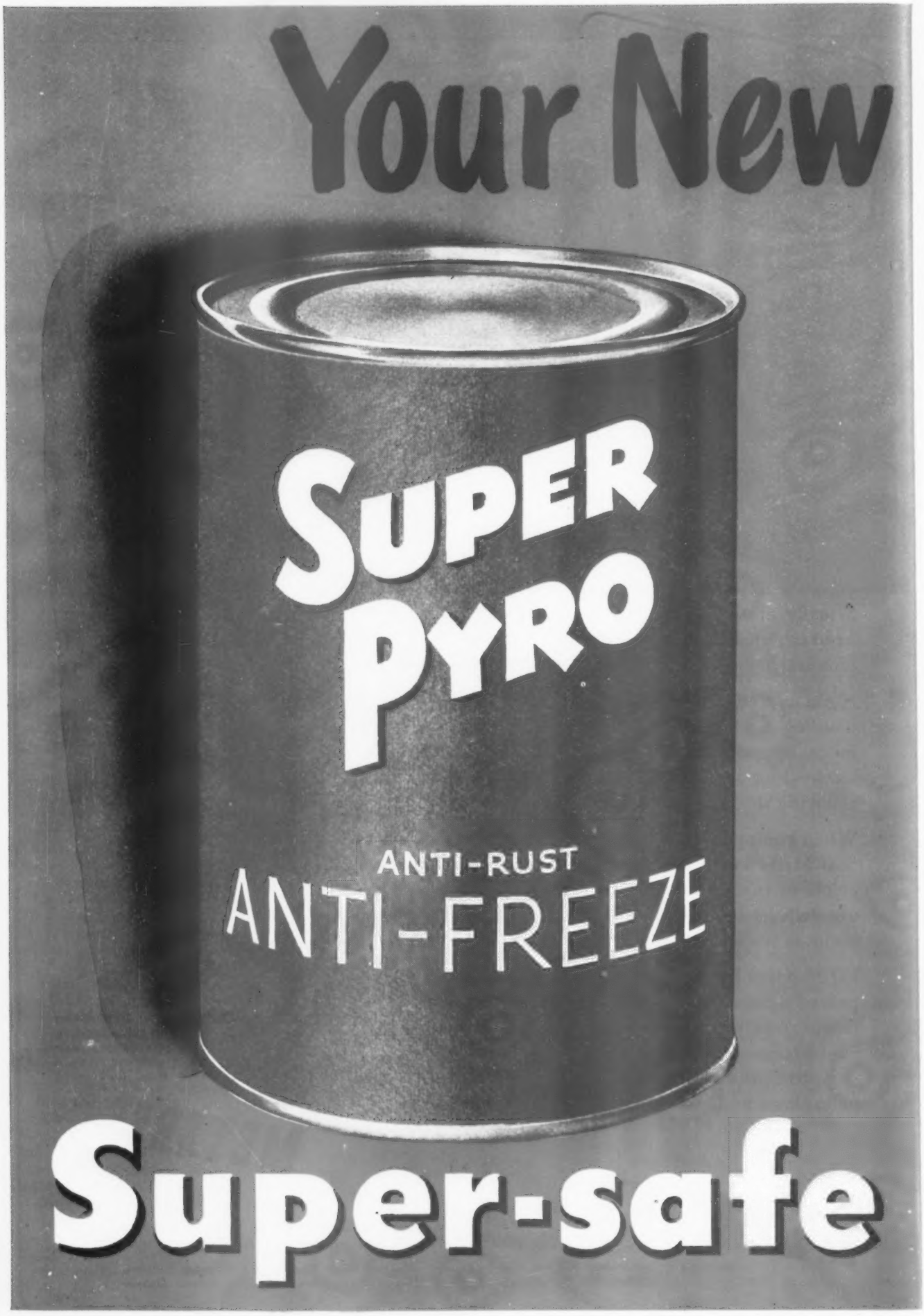
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SUPER PYRO

Mr. LaFortune

Mr. Buchanan

and Edwards. Sutton Bros. in 1908 built a small plant at Sistersville, W. Va.

About the time Mr. Fasenmeyer was building his first machine, young Ed Hanlon was persuading the small oil production firm of Heneghan and Daly that it ought to have a bookeeper. Mr. Heneghan, it appears, was one of the early oil industry's "hip pocket" bookkeepers, who made his memos in a little notebook, and when a transaction was completed, he tore out the page and threw it away. When Ed Hanlon came into the firm, that was changed. And in 1904, when Mr. Daly died, the firm name became Heneghan and Hanlon, the first of the seven Hanlon companies.

First Try Is Successful

Mr. Hanlon's first effort at manufacturing natural gasoline was a success —with a $300 compressor bought by him. A second plant was built in 1909. Capacity of the plants was six iron barrels per day. The output was marketed in steel drums, transported by ox or mule team and river boats.

In Tulsa, during World War I, Mr. Hanlon became associated with the Chestnut and Smith Corp. as a vice president and in 1929 when the company sold out to Lone Star, he joined with D. E. Buchanan, another vice president, and J. H. Boyle, secretary, in the formation of Hanlon-Buchanan, Inc., primarily for the marketing of natural gasoline.

Mr. Hanlon has spent much time traveling abroad, except during the war. Just outside the door of his comfortable office in the National Bank of Tulsa Building is a Chinese temple gong, sent to him by friends in China. A Chinese rug covers the floor of the office, which is done in black Hawaiian mahogony paneling.

He plans to retain the office and is organizing the Hanlon Oil Co. to operate 10 small natural gasoline plants in the Sistersville, W. Va. area, which were retained out of the sale to Warren Petroleum.

Mr. Hanlon has been chairman of the board of directors of the National Bank of Tulsa for about 10 years. He is a bachelor.

Contributed to Industry's Progress

D. E. Buchanan has made two outstanding contributions to the industry. As the Natural Gasoline Assn. of America's second president he helped sponsor development of the first method of determining vapor pressure and of methods for determining the quantity of natural gasoline in gas. Second, he inaugurated and fostered over a long period the export of natural gasoline in bulk to England and Europe.

Mr. Buchanan was one of the organizers of the Natural Gasoline Assn. of America, and has been active in it during its 25 years. Through the association, as well as in his own business, he has constantly worked toward a more scientific, more self-confident, better stabilized industry.

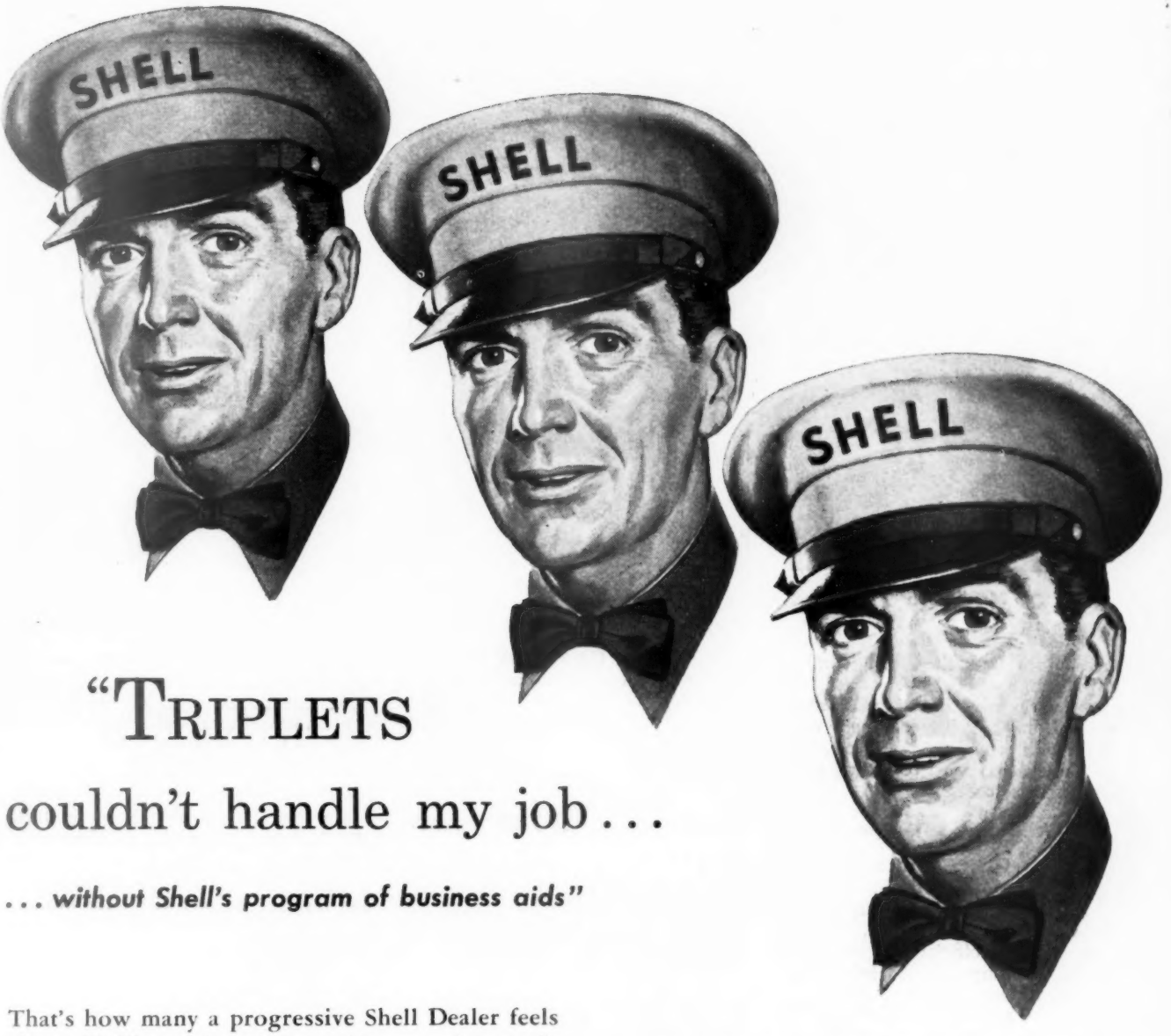
With the advent of high pressure stabilization about 22 years ago, Mr. Buchanan conceived the idea that the new product could be transported in bulk similar to high quality motor fuel.

He shipped 15 drums of it to various refiners in Europe in 1926 to demonstrate its blending value, which was recognized, but they were still skeptical about losses in transist. However, he

Handles 16% of Total Natural Gasoline Sales

TULSA—United States production of natural gasoline and related products—propane, butane, butane-free gasoline and heavier —in 1945 totaled 111 million bbls. (4,662,000,000 gals.), according to J. H. Dunn, president of the Natural Gasoline Assn. of America. On that basis, Warren Petroleum, with the three-quarters of a billion gallons handled by Warren and Hanlon-Buchanan in 1945, will be selling approximately 16% of the total.

In the over-all production of natural gasoline and LPG, Phillips Petroleum Corp. is the generally acknowledged leader, but Phillips retains a majority of its volume for its own use in blending with motor fuel and other refinery products and for jobber sale. This leaves Warren in first position in what may be described as the "open spot" market, and probably second or third in total manufacture and sales.



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1. Which among the following services will you buy from the same man who sells you your gasoline and oil?

   a. Lubrication **c. Motor tune-up**
   b. Car washing **d. Replacement of worn parts**

2. Would you prefer air and water at

   a. The pump island? **b. The side of the yard?**

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SHELL

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Mr. Allison

Mr. Boyle

Mr. Miller

agreed to sell Deutsche Erdol (Olex), a trial part-cargo of 50,000 bbls. and take payment on landed quantities in shore tanks at Hamburg. The shipment went through with less than 1½% loss, and from then on the export of natural gasoline gained in volume.

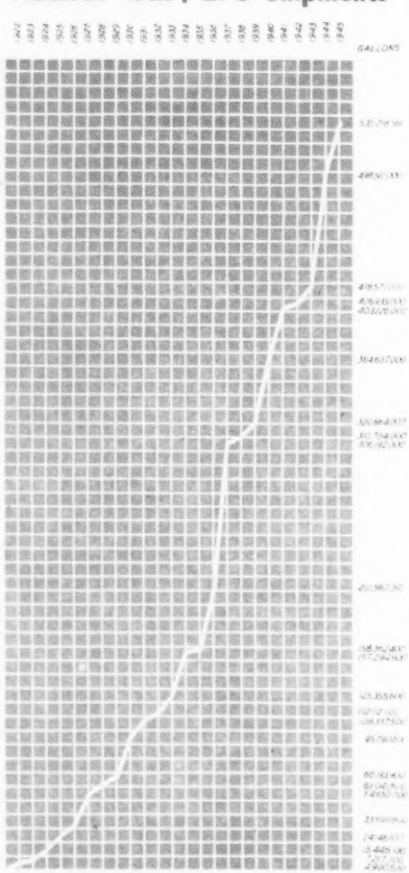
Well Known in Europe

As result of Mr. Buchanan's many trips to Europe in furthering exports, he is about as well known there among oil men as he is in the states. He was chairman of the official delegation selected by Secretary Cordell Hull of the State Department to represent the United States at the Second World Petroleum Congress held in Paris, France, in June, 1937. He also served as chairman of the API delegation to the same Congress. It was on that trip that he and Mr. Hanlon had an audience with Pope Pius XI. Mr. Buchanan had been previously decorated by the Pope with the highest honor that can be conferred upon a non-Catholic. Bestowal of the gold medal was in recognition of his work as chairman of the drive which raised $775,000 in 10 days for completion of St. Johns Hospital, Tulsa.

Born at Beaver Dam, Ohio, on Mar. 31, 1892, Mr. Buchanan left school when 14 and went to Springfield, Mo., and in 1908 started to work for the Frisco railroad as timekeeper. After eight years in various capacities in the operating division, he entered the oil business as purchasing agent for the old Sapulpa Refining Co. He joined Chestnut & Smith Corp. at Tulsa as sales manager in 1918, and was vice president in charge of sales when the company sold out to Lone Star Gas Co. in 1929. He then joined with Messrs. Hanlon, Boyle and Waters in organization of the Hanlon-Buchanan group of companies. He was president of Hanlon-Buchanan, Inc. and Hanlon Pipeline Co., and vice president of the other companies until the sale to Warren.

Mr. Buchanan has been a member of the API board of directors since 1922, and chairman of the membership committee for 10 years. He took leave of absence from his companies in January, 1942, to become chief of the Natural Gas and Natural Gasoline Section, PAW Dist. 3, at Houston. He was later named PAW Dist. 3 director-in-charge, where he served until December, 1943.

His principal hobby is pure bred Hereford cattle, although he plays some golf. He is a member, Southern Hills Country Club, Tulsa Club, Denver Club and the API 25-Year Club. He belongs to the First Christian Church. On July 6, 1912, he and Ruth Peake of Springfield, Mo., were married. They have three daughters, all married, and four grandchildren.



Annual shipments of natural gasoline and liquefied petroleum gas by Warren Petroleum Corp.

Joseph A. LaFortune, executive vice president of Warren Petroleum Corp., introduced the idea of making the Warren organization a manufacturers' sales representative. It had been in its first years, a marketing company.

Mr. LaFortune, who was a member of the National Petroleum News advertising staff in Tulsa in 1921-22, joined Warren in 1924, pulling up his chair beside the double desk occupied by Mr. Warren and Mr. Brown.

Natural gasoline marketers then were mostly brokers. In an irregular, flashy market, they could go bankrupt overnight or in a single day. They resembled the early-day product they sold, which sometimes exploded and burned without apparent cause.

Dealt Direct with Customers

"Customers 22 years ago wanted to deal directly with manufacturers," Mr. LaFortune said the other day. "So I made a contract with Pioneer Gasoline Co. of Shreveport for 45 tank cars monthly. We then had something definite to sell—and deliver. We were no longer just brokers. We were sales rep-

These two Buckeye leaders meet most nozzle needs:

☛ **No. 820 (Automatic Shut-off)**

☛ **No. 800 (Conventional Type)**

You make the choice!

BUCKEYE-OPACO
HOSE NOZZLE VALVE NO. 820

BUCKEYE
HOSE NOZZLE VALVE NO. 800

WANT QUICK, easy, accurate refueling? Of course! And either or both of these Buckeye nozzles are designed to give it to you best. No. 820 shuts off automatically when fuel covers tip of spout, eliminating guesswork, waste and preventing overflow. This valve is ideal for busy service stations, airports and bus terminals.

No. 800 is the conventional type. Light and sturdy, it is streamlined inside for fast flow without turbulence, outside for modern appearance.

Mail the coupon today for full facts.

Buckeye

DAYTON

Quality Valves and Fittings
for the Oil Industry

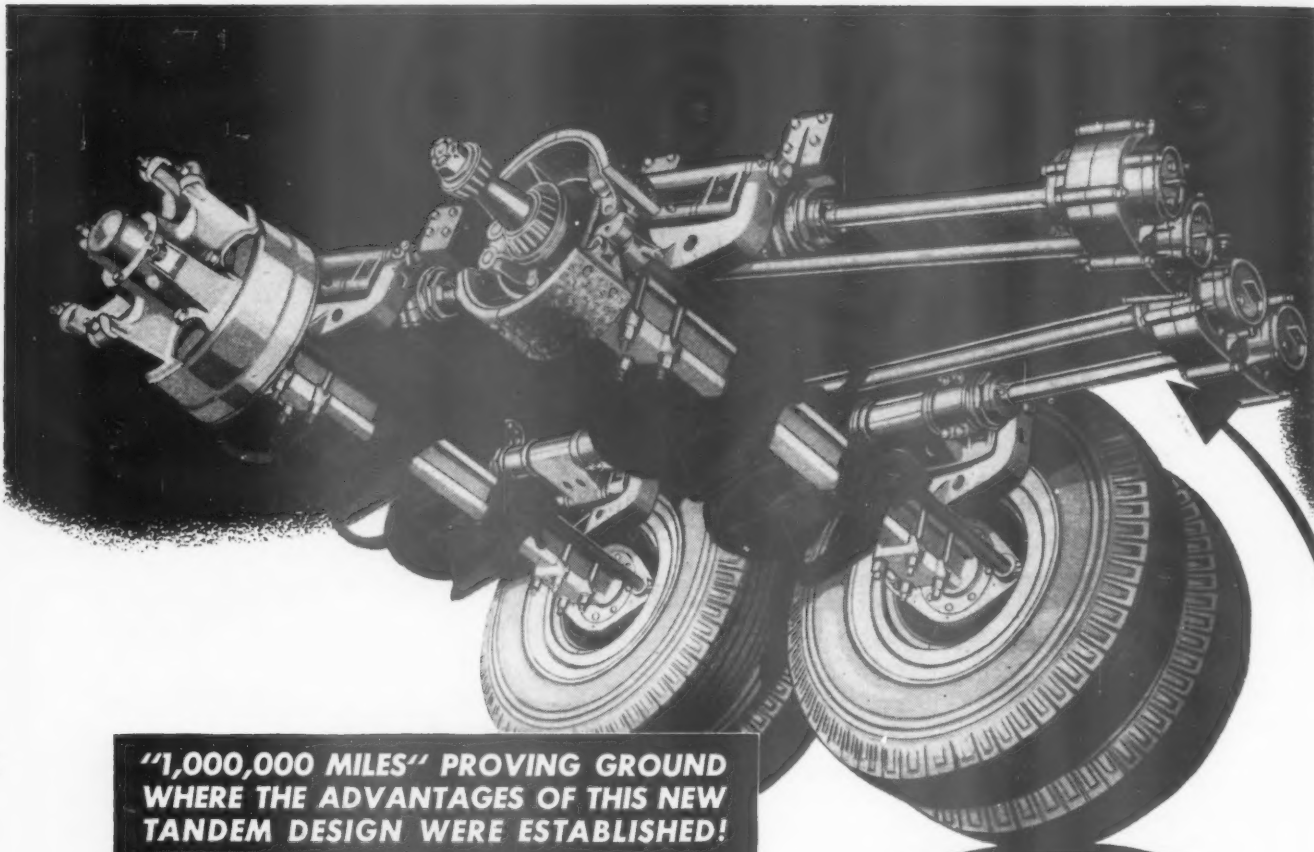
Buckeye Iron and Brass Works
356 East Third Street
Dayton 2, Ohio

Please send complete facts on all *Buckeye Hose Nozzle Valves.*

Name_____

Address_____

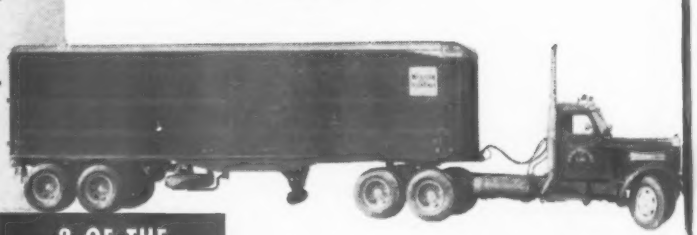
City_____ **State**_____



"1,000,000 MILES" PROVING GROUND WHERE THE ADVANTAGES OF THIS NEW TANDEM DESIGN WERE ESTABLISHED!

Road tested for 2 years over rugged mountainous Western highways, under all road conditions—a total of more than 1,000,000 miles! Maintenance and tire costs are cut tremendously with Gravity Suspension Tandem.

Replaces
LEAF SPRINGS, CONVENTIONAL HANGERS and RADIUS RODS



2 OF THE TEST UNITS THAT HAVE ROLLED UP NEW TIRE-MILEAGE RECORDS!

★ *"Engineered Transportation"*
Reg. U. S. Pat. Off.

GRAVITY SUSPENSION TANDEM

Exclusive FRUEHAUF Underconstruction!

THIS TANDEM-AXLE UNIT PROVIDES . . .

1. **PERFECT SPRINGING**—"Feather-soft" when light—with spring action exactly proportional to the load.
2. **BRAKING SMOOTH & SURE**—no chatter — no wheel hop—Torsion Bar Springs eliminate this.
3. **LONGER TIRE LIFE**—you forget about destructive tire scuffing. Axles "follow the curves" automatically in all normal in-and-out on-the-highway travel.
4. **GREATER SAFETY**—hugs the road on turns. Axles ride road contours independently, to provide "sure-footedness".
5. **LOWER MAINTENANCE**—all bearings are lubricated for life. Radius rods, leaf springs, conventional hangers are discarded.

For complete facts about this new Tandem, just ask at your nearest Fruehauf Branch for the "Tandem Booklet". A penny postcard will bring this informative "working model" by return mail.

World's Largest Builders of Truck-Trailers

FRUEHAUF TRAILER CO.

DETROIT 32, MICHIGAN

8 Factories—60 Factory Service Branches

FRUEHAUF Trailers

H. W. Harts, vice president in charge of manufacturing for Warren Petroleum

John T. Oxley, secretary and assistant treasurer of Warren Petroleum

Sam I. Hulse, vice president in charge of natural gasoline sales for Warren

resentatives for a manufacturer. That meant something to buyer customers."

Warren now has 56 such contracts, including 16 taken over from Hanlon-Buchanan.

Another policy adopted by the company in its early days was to avoid getting into any phase of refining. Warren Petroleum did not wish to compete with its customers. These two policies, plus a keen eye for expiring contracts of competitors, proved to be business builders.

In addition to being executive vice president of Warren Petroleum Corp., Mr. LaFortune is vice president of Natural Gasoline Corp., and of Salem (Ill.) Gas Pipeline Co.; director, Southern Hills Country Club and of Tulsa Community Fund; president of board of directors, Casia Hall, Tulsa boy's preparatory school with 145 students; member, board of lay-trustees, Notre Dame University.

Financial Data

TULSA — The three principal stockholders in Warren Petroleum are W. K. Warren and family, about 45%; J. A. LaFortune and family, 21%; H. E. Felt and family, 7%. The company is capitalized at $3,000,000, represented by 600,000 shares of common stock with par of $5 and which was selling on the New York Stock Exchange on May 29 at 28⅝ a share. The stock was listed on the Exchange last year when 25% of the total shares was offered the public. Since then about 25,000 shares have been repurchased leaving 125,000 shares not closely held.

Two years of university training at Notre Dame came to Mr. LaFortune the hard way. He was born at South Bend, Ind., in 1895. A friend, Stanley Winchell (not related to Walter), didn't want young Joe LaFortune to waste his time so he arranged a special course for him—commercial arithmetic, commercial law, journalism, psychology, chemistry and English.

"The first year," Mr. LaFortune said, "I worked my way through by picking up papers on the campus and the second year, by dusting, or readying the art room. That was in 1915-16."

During the second week in May of this year, the former student at Notre Dame returned there and made the university an unrestricted gift of $100,000. Asked what the money should be spent for, he suggested an information building and bus station at the entrance to the ground. Doubtlesss he recalls boyhood experiences of waiting in the rain and snow for the bus during his two winters of schooling.

While attending the university, he met Miss Gertrude Tremel of Mishawaka, Ind. They were married on April 22, 1920, and now have four children. Jeanne, the eldest, will be married this summer. Mary Ann and Joseph, Jr., are twins and 21. Robert James is 19. Joseph, Jr., returned home the first week in May after three years in the Navy as an aerographer. Most of his service was spent in the South Pacific. He now plans to study petroleum engineering at the University of Oklahoma. Robert James is a cadet on board the Cape Alexander, a supply ship in the Mediterranean. He has been in the Navy for a year.

Howard E. Felt, vice president of

W. K. Warren, center, presents 10-year pin to S. J. Hulse, right, vice president of Warren Petroleum. L. A. Jackson, left, president of Warren Activities Assn., looks on as presentation is made at association spring party

Improve your lubricating oils with PARAMINS*

For several years, PARAFLOW has been the trademark for a well-established and widely known line of petroleum improvers. Now these additives are known as PARAMINS*.

Aside from this change in name these improvers are the same dependable products that have been developed by America's largest petroleum research laboratories to enable you to produce better lubricating oils.

PARAMINS* INCLUDE:

PARATONE — For Higher Viscosity Index.
PARAFLOW — For Lower Stable Pour.
PARANOX — For Inhibiting Corrosion and Oxidation.
PARASHEEN — For Improving Appearance.
PARATAC — For Tackiness in Oils and Greases.
PARAPOID — For E. P. Lubricants.
PARADYNE — For Improved Gasoline.

Remember . . .

PARAMINS*

*TRADEMARK

Make Good Oils Better.

DISTRIBUTED BY:

STANCO DISTRIBUTORS, INC., 26 Broadway, New York 4, N. Y.
STANCO DISTRIBUTORS, INC., 221 North LaSalle St., Chicago, Ill.
THE CARTER OIL COMPANY, P. O. Box 801, Tulsa, Okla.
GRIFFIN CHEMICAL COMPANY, Los Angeles and San Francisco, Calif.
IMPERIAL OIL, LTD., 56 Church Street, Toronto 1, Can.

A. J. Murphy, treasurer and assistant secretary of Warren Petroleum

Warren Petroleum in charge of the liquefied petroleum gas division, has charge of all sales of LPG to distributors, industrial firms, chemical companies and other users of butanes and propane. Like his boss, W. K. Warren Mr. Felt is a market builder, working in the specific field where the industry has had its biggest growth in recent years and where it sees a great future, with industry estimates eyeing a potential of 13,000,000 domestic LPG users compared with 2,000,000 at present.

Mr. Felt joined Warren in February, 1929, shortly after the death of Mr. Brown.

Born at Kane in Western Pennsylvania in 1894, Mr. Felt grew up in Franklin, Pa. He was graduated from the Wharton School of the University of Pennsylvania in 1917 with a degree in economics. Immediately after graduation he entered the Army and served overseas for a year.

Having worked for Atlantic Refining during his school days, he joined Atlantic's sales department in Pittsburgh after the war. A year later he went with the old Shaffer Oil and Refining Co. at Gahegan, La. In 1920 he became assistant manager of the Tulsa office of the American Petroleum Products Co., where he stayed until 1926 when he joined Dale W. Moore as a buyer. He went from Dale W. Moore to Warren Petroleum.

Mr. and Mrs. Felt have three daughters and one granddaughter.

J. H. Boyle is the only one of the three organizers of the Hanlon companies who will continue as an official of Warren Petroleum. Mr. Boyle was the chief operating executive of the Hanlon companies, in direct charge of natural gasoline manufacture and oil and gas production as well as the routine operation of the properties.

Mr. Boyle is known throughout the industry as a man with unusual ability to co-ordinate the work of technical men with that of operating and sales executives. He was born in Houston and moved to Tulsa in 1916 as auditor for the old Phoenix Refining Co. at Sand Springs, Okla. When Chestnut and Smith Co. purchased Phoenix during World War I, Mr. Boyle continued with the company. Mr. and Mrs. Boyle have one daughter and two grandchildren.

Ray E. Miller, who was vice president in charge of sales for Hanlon-Buchanan and will remain with Warren Petroleum, is a former secretary-treasurer of the Natural Gasoline Assn. of America. Among his contributions to the petroleum industry is advancement of safety work.

Born in Burlington, Iowa, and educated at the University of Missouri, Mr. Miller served in the Air Corps during World War I. In 1920 he started with Marland Refining Co. (now Continental Oil Co.) as assistant to the manager of the insurance department. Because his work in personnel attracted the eye of executives, he was placed in charge of the safety section. In 1925 he organized a safety section for Mid-Continent Oil and Gas Assn. In 1928 became secretary-treasurer of the Natural Gasoline Assn. He joined Hanlon-Buchanan in 1934. Mr. and Mrs. Miller have one daughter.

James E. Allison, general counsel for the Hanlon companies, will handle with Warren virtually the same duties he had with his former affiliation. He is a native Texan, a graduate of the College of Law of the University of Texas. Prior to becoming a full-time Hanlon executive in 1937, he engaged in general practice at Breckenridge, Texas, representing natural gasoline companies. Mr. and Mrs. Allison's only son is now a law school student.

'Jack Rabbit Days'

TULSA—In Tulsa's early boom town days, about the time of World War I, many an oil field worker, who is now a prominent Tulsa citizen, lurched in and out of town on "drip" gasoline—casinghead natural, caught by hanging a bucket over the end of a gas waste line beside the road. Poured into the gas tank, "it would make a Model T jump a 10-rail fence and never touch a tail feather."

Mr. Felt

NPN Inspection Forms Spur Friendly Competition

By NPN Staff Writer

Several oil marketers are using NPN's Service Station Housekeeping Inspection Forms to create friendly competition among managers and dealers.

A jobber in Connecticut is sponsoring a contest among dealers for a period of three or four months. Dealers with best housekeeping scores during that time will be presented with victory bonds. Inspections are being made by a member of his organization who doesn't have regular contacts with the dealers.

The dealers will be divided into two classes; small service stations and large. A bond will be given in each class.

The manager of one of the largest oil distributing companies in Georgia personally made inspections of all his stations with NPN forms, graded the stations and turned the results over to the station managers so that corrections could be made. This marketer expects to repeat this procedure every month.

A Pennsylvania marketer uses the housekeeping forms as a standard check of his own outlets. He also uses it in making a check of prospective outlets. When these outlets are taken over, there is no question as to what should be done to bring them up to high standards. He has the retail sales manager make a personal check-up and rating of each one of the company operated and leased stations. Also he has wholesale sales representatives supply the forms to the company's gasoline dealers who check up on themselves.

The division manager of one of the nation's largest independent oil companies outlined a program to start June 1. He is furnishing territory managers with enough of the forms to make an inspection and rate all of the company service stations in their respective territories.

A plaque will be made and awarded with appropriate ceremonies to the station with the highest score.

Bennett
THIS SALE
$000
GALLONS
000
Built
TO PERFORM
Better
Longer
AT
Less Cost
SERVICE STATION EQUIPMENT COMPANY
MUSKEGON, MICHIGAN
A COMPLETE LINE OF DISPENSING
EQUIPMENT FOR SERVICE STATIONS

Prominent display of the "Approved Safe Clean Service" sign helps advertise the service to customers

'Approved Service'

Housekeeping, Merchandising and Service Must Be Grade 'A' To Display the Sign

By Herbert Taylor
NPN Staff Writer

The value of on-the-job training is not being overlooked by Skelly Oil Co. in the current program of rejuvenating its "Approved Service" program.

The Skelly service program, interrupted by the war, is once more in force and throughout the company's marketing territory "Approved-Safe-Service" signs are reappearing. They are being installed at outlets where Skelly management ordered them pulled down during the war as help and service conditions disqualified the stations.

The motivating factor behind the renewal of "Approved Service" plan is on-the-job training. Skelly management says:

"Experience has shown there is only one way to make a merchandising and service program work, and that is to have a trained, experienced 'Service Merchandising' representative come to the station, train the personnel in every angle of service and selling, right on the job. The studying of books or bulletins and the attending of classroom discussions just won't get the job done. We have learned this from plain on-the-job experience."

Skelly's "Approved Service" program is primarily a merchandising and service plan developed for Skelly outlets meeting certain definite requirements. Dealers participating in the program, which is voluntary, must meet a few common-sense specifications and they must agree to live up to these requirements and support the program in its entirety.

There is nothing unreasonable or impossible required in order to qualify. Size and location of the station is not considered. Some of the smallest one-man stations joined the program at its outset before the war and have maintained it for years.

Six Requirements

The six principal requirements are:

1—Agreeing to maintain clean, efficient station facilities—including "Approved Safety-Checked Restrooms."

2—Agreement to put attendants into complete, clean, Skelly regulation uniforms.

3—Agreement to give official "Skelly Approved Safety-Check Driveway Service."

4—Agreement to give complete official "Skelly Grease-Master Service" if the station has lubrication facilities.

5.—Agreement to push and sell Skelly's line of accessories—and to give efficient car maintenance check-up service.

6—Agreement to co-operate with the Skelly merchandiser in the thorough training of personnel.

Application to join the "Approved Service Program" is made through the company's retail district managers, wholesale representatives, or direct to a company service merchandiser. These merchandisers, all thoroughly schooled in the entire plan, go through the program with the applicant. There is then no question as to what it takes to qualify. Applications then are sent to the company management and are handled as received.

When the application is approved, it is turned over to one of the company's service merchandisers, who then takes over and follows through until the station is qualified to display the "Approved-Safe-Service" signs. This sign in a sense is a diploma. It signifies that the operator has "graduated" after a practical course in housekeeping, merchandising and operations. It means that the outlet meets Skelly's code of marketing principles.

Continued Performance Mandatory

Following the originally prescribed regulations and procedure is mandatory once the approved sign is erected. It comes down when they are not followed, as was the case during the war when about half of the Skelly outlets previously qualified as "Approved Stations" lost this status. Merchandisers make frequent return visits to check-up on performance.

These service merchandisers are men picked for their sales and merchandising ability and their skill in training men. They travel in white merchandising trucks, and carry a complete set-up of Skelly "Approved Service" advertising materials, station clean-up supplies (offered at cost), lubrication supplies and a working stock of maintenance-type Skelly accessories—enough to take care of a station's needs, while the merchandiser is on the ground.

The merchandiser spends from three

Proper attention to cleaning windshields and inflating tires as well as filling the customer's gasoline tank is part of the Skelly merchandising program

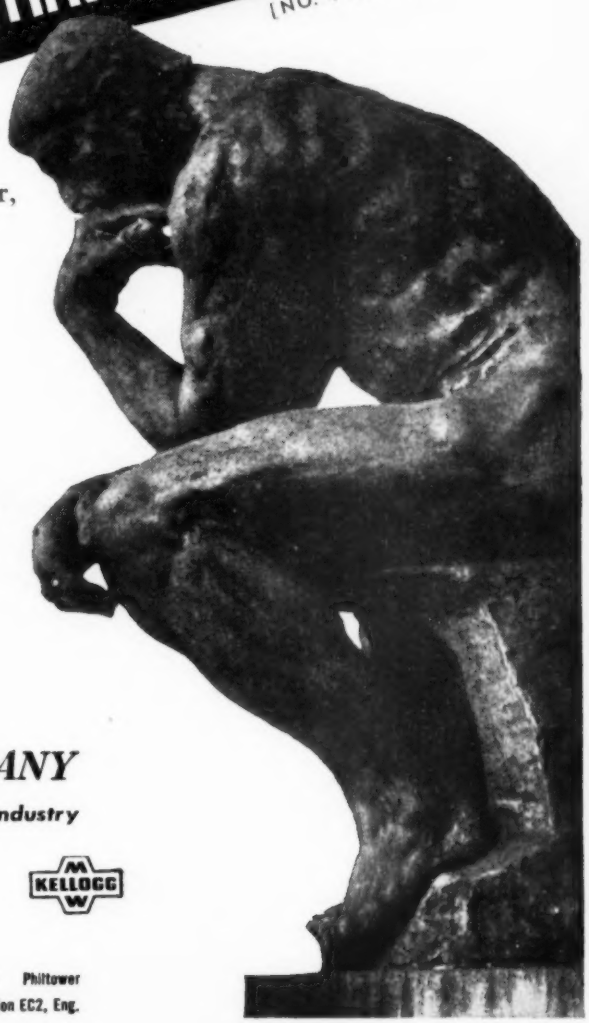
the proposition **External equipment for adding or removing heat—or provision for its installation—should be included in any design for Fluid cat-crackers.**

the facts It is thoroughly practical to design and build a heat-balance Fluid cat-cracker in which the heat formed in regeneration of the catalyst is sufficient to balance the heat required in the reaction phases. But such a unit, while sometimes more economical as to initial cost, can operate at top efficiency only on the originally planned feed.

In view of the probable variation in future charging stocks, and the certainty of changing requirements for quality of products, greater flexibility of any new unit becomes of paramount economic importance. To take full advantage of the flexibility which makes a Fluid cat-cracker so valuable in refining operations, every consideration should be given to the addition of a pre-heat furnace and, perhaps, a recycle catalyst cooler.

thinking it through

[NO. 4 OF A SERIES]



Such equipment need not be installed initially where heat-balance operations are currently predictable. However, where not installed initially, provision for future addition of such flexibility devices should be included in any design.

the conclusion **There is no substitute for the *best* design.**

THE M. W. KELLOGG COMPANY

Engineers and Economists to the Petroleum Refining Industry

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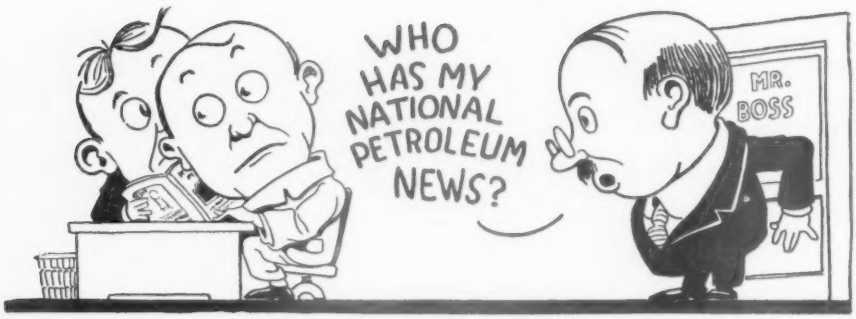


Did You Borrow It?

HOW often have you heard the Boss say: "Who's got my copy of National Petroleum News?" And then you wish you hadn't borrowed it again!

You can get your own copy regularly for less than 10c a week . . . Yes, for just a few cents a week, you and every man in the oil industry who wants to study its development and become a better oil man, can have his own copy—at the office or home—to study and think over.

Knowledge and ideas are making profits for all today. And *it's knowledge of the oil industry itself* that is necessary to get profit (or salary increase) from that business.

NATIONAL PETROLEUM NEWS continues to be available at $5.00 for 52 issues in spite of increased costs for printing and other items all along the line. NPN continues to furnish to every reader a staff of expert oil writers located at the important oil centers, correspondents in outlying fields, and many articles by recognized authorities on marketing, operating and transportation.

So if you did borrow this issue or can use another copy, each week, for study in your office or at home—Guarantee yourself the next 52 issues for $5.00—TODAY!

NATIONAL PETROLEUM NEWS 6546
1213 W. 3rd St., Cleveland 13, O.

Send the next 52 issues of National Petroleum News to me at the address given below. Enclosed is a check, (draft or money order) for $5.00. (Canada and Foreign $6.50).

Name _____

Street or Box _____ City-State _____

Company _____

Branch of Industry engaged in _____

to five days at the average station up for approval. Following a complete check-up of the station, correction is made on items not meeting the standard of requirements.

Good Housekeeping Required

The physical make-up of the station is then put in order. This includes the building, all equipment, signs, night illumination and other items such as are found in NPN's Housekeeping Inspection Form.

Next is put into effect a roster of duties to follow (on a positive typed schedule) for operating and maintaining a clean service station and restrooms.

Attractive displays and adequate stocks of oils, greases, tires, batteries and accessories are then installed.

A card system for recording customer's needs and new customer solicitation effort is placed into operation.

The service merchandiser then proceeds to train personnel in correct driveway service, lubrication service, accessory selling, knowledge of all products sold, keeping up appearance in regulation uniforms.

The operator is taught how to keep thoroughly posted on the station's sales progress and profit picture by maintaining an adequate, simplified accounting system.

Where a station has lubrication facilities, it is mandatory that the operator make application for and take on the Skelly lubrication plan, designated as "Skelly Grease-Master Service". The merchandiser carries a special application form which is filled in by the station operator during the period the station is under training.

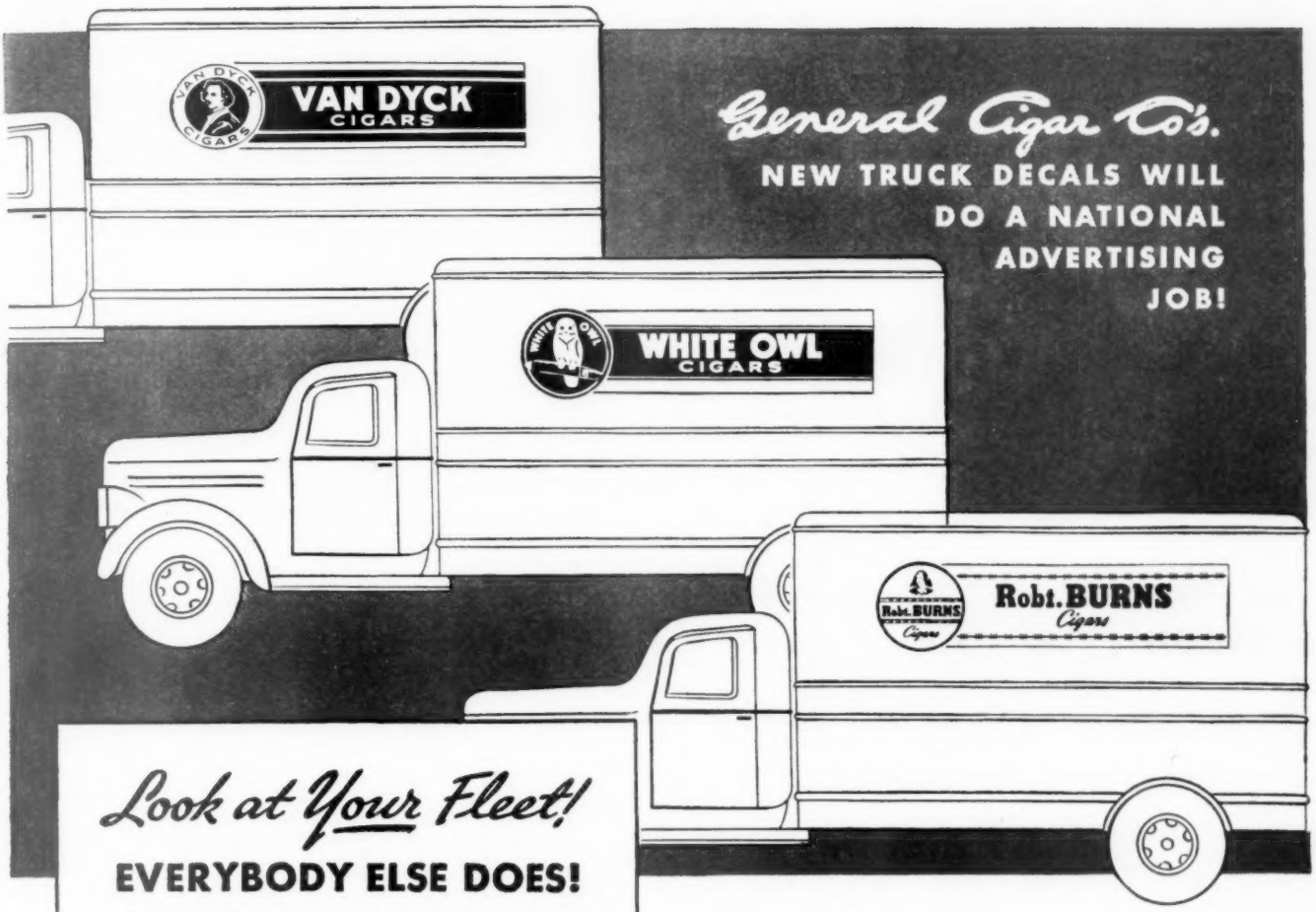
Trained in Lubrication

The service merchandiser then trains the personnel in all the angles of lubrication service, including good housekeeping procedure in the lubritorium. He teaches the operators how to sell lubrication service by contacting local customers and by making demonstrations. This is augmented with a display panel the Service Merchandiser carries in his white panel merchandising truck. This is placed on the end of the pump island. Another board, placed on the other side of the island, displays fast-moving replacement accessories. These have proved effective sales-getters, and often increase the overall sales at the station immediately.

Once a station is approved, a Skelly Approved Service metal sign is hung on its own bracket below the regular Skelly identification sign. Posters, announcement postcards, insurance policy type folders, the Skelly Approved Service "Award" Manual, the Skelly Code of Principles, and other office and restroom signs are put to work to announce the coming of this service to a station operator's customers and prospective customers.

In addition to Skelly dealers, of which there are more than 2000 expected to

MILES OF FREE ADVERTISING WITH *MEYERCORD DECALS*



General Cigar Co's.
NEW TRUCK DECALS WILL DO A NATIONAL ADVERTISING JOB!

Look at Your Fleet!

EVERYBODY ELSE DOES!

Don't let the "free" advertising space on your trucks "go to waste." Side panels, rear doors, tops, visors and cabs offer miles of mobile advertising. And Meyercord Truck Decals offer the most efficient, low cost method of getting it. Trademarks, products, slogans, in any size or colors can be reproduced in durable, weather-tested Meyercord Truck Decals. They're economical for a dozen trucks or a thousand. Overnight application saves "off the street" truck time loss. Learn how the "free" advertising space on your trucks can help them pay for themselves. Write Department 36-6

WHAT GENERAL CIGAR COMPANY SAYS ABOUT THE USE OF TRUCK DECALS . . .

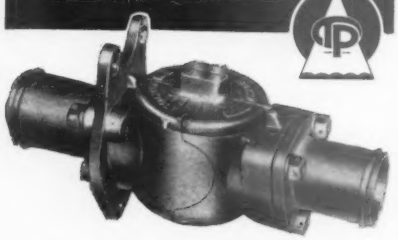
"Attractive auto signs have long been recognized by progressive distributing organizations in every field as an effective, practical way to tell consumers and dealers of the quality goods they handle. For several years past, a number of our distributors have featured our National Brands on their cars and trucks. We have been happy to participate in this mutually beneficial enterprise by furnishing the finest signs suited for the purpose, that money could buy."

FREE! This Meyercord truck visualizer will help you plan. Send for it today.

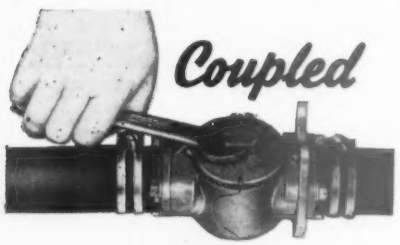
©1946, Meyercord Co., Chicago

THE MEYERCORD CO.
World's Largest Decalcomania Manufacturers
5323 WEST LAKE STREET • • • CHICAGO 44, ILLINOIS

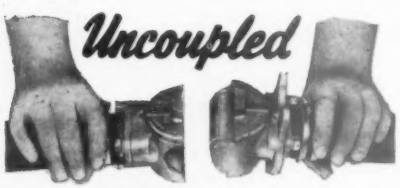
Thompson
QUICK-disconnect
COUPLING



for transferring
AROMATIC FLUIDS
and LUBRICANTS in
TANK CARS, TANK
TRUCKS, REFINERIES,
BLENDING PLANTS



Extremely quick coupling and uncoupling; patented design; non-corrosive; air tight; originally developed and manufactured by Thompson Products for wartime aviation.



A quarter turn separates the hose, positively sealing both ends. Either end may be drained when uncoupled. Rejoining is as simple as uncoupling.

No FUMES or WASTE,
EXTREMELY FAST

DIAMETERS 1/4 IN. TO 3 IN.
— FOR HOSE OR PIPE

Illustrations show one type of the Thompson *Quick-disconnect* Coupling. May our engineers discuss *Quick-disconnect* applications for your special requirements?

Thompson Products
ACCESSORIES & PARTS DIVISION
CLEVELAND 17, OHIO
(PHONE: IVANHOE 7500)

participate, all company operated and master service stations are required by the management of the company to apply for and live up to the regulations of this program.

To date more than $120,000 has been invested in the program. Six merchandising trucks, operated by trained merchandisers are in the field. A fleet of at least 15 is planned as truck equipment and trained men become available.

The company's educational program through the "Skelly Institute of Marketing" is providing 30-day courses of instructions for use in educating company salesmen qualified for service station merchandisers. A manual of instruction, prepared by department heads, is used in this educational program. Each class receives preliminary instructions in the institute meeting room in Kansas City. They are then taken to the company's El Dorado refinery and other plants for technical study of manufacturing process. Several days are spent in the company's head office at Tulsa studying the functions of management. Final instructions in the course will be concluded along the specific lines each salesman wishes to qualify for—service station merchandising, bulk plant operation, industrial lubrication and other branches.

Pennsylvania Marketers Group Formation Discussed at Meeting

Special to NPN

HARRISBURG, PA.—An association of gasoline and fuel oil marketers for Pennsylvania will be formed in the near future, if plans discussed recently at a meeting of 28 jobbers and distributors prove practicable.

Group, composed chiefly of men within motoring distance of Harrisburg, dined at Penn Harris Hotel here May 22, and, after considerable discussion, unanimously decided that formation of such an association was advisable. Those attending the dinner, however, believed that a more representative meeting should be called for organization purposes, and the following temporary officers were asked to arrange a larger gathering soon:

Chairman: L. H. Setzer, L. H. Setzer Petroleum Co., Camp Hill, Pa.; secretary: H. E. Oberman, Keystone Oil Products Corp., Camp Hill, Pa.

Wisconsin Jobbers to Play Golf

Special to NPN

MADISON, Wis.—Wisconsin Petroleum Assn. is staging its annual golf tournament and stag party June 18, at Dell View Hotel, Lake Delton, Wis. Eddie Peabody, exponent of the banjo, will be one of the featured entertainers.

N. J. Oil Trade Golf Tourney Set

Special to NPN

NEWARK, N. J.—The annual championship golf outing of New Jersey Oil Trade Assn., Inc., will be held Thursday, June 20, at Suburban Golf Club, Union, N. J. Festivities will also feature buffet lunch and broiled steak dinner.

Chicago Oil Men's Club Drive Boosts Resident Membership

NPN News Bureau

CHICAGO—Chicago Oil Men's Club spring membership drive has raised total number of active resident members to 250 and 90 non-resident members, according to Henry G. Plane, president.

Goal set for the drive is 300 resident members by July 1, after which time membership will be considered closed, automatically creating a waiting list with restoration of initiation fee.

Oil Burning Furnace Shipments

WASHINGTON—Commerce Department reports factories have shipped 16,798 of the 20,155 floor and wall furnaces, oil and gas types, produced in March. Shipments were valued at $767,934. Factories also shipped 4050 oil-burning forced air type furnaces, valued at $791,763, and produced 3633 in same month.

Gasoline Sale Hours Are Cut In Toronto And Windsor, Ont.

Special to NPN

TORONTO, Ontario—This city and Windsor, Ontario, have been authorized by Industrial Standards Board to restrict the hours for sale of gasoline in service stations from 7 a.m. to 7 p.m. on week days. Sundays, specially designated stations will remain open between 10 a.m. and 5 p.m. Each station, under new setup, is to be permitted 12 open Sundays a year.

With more than 700 service stations here, about 200 will remain open for 7 hours of Sunday service. In Windsor a local statute provides for Wednesday afternoon closing.

Ontario Motor League officials are asking that provision be made for the sale of gasoline to emergency travellers as in other provinces where general sale is limited by law. Prince Edward Island, New Brunswick, Quebec, Manitoba and Alberta have no restrictions.

Will Handle Wiggins Tank Roofs

Special to NPN

HOUSTON—License arrangement has been affected between General American Transportation Corp. and Wyatt Metal & Boiler Works whereby Wyatt will sell, fabricate, erect and service Wiggins tank roofs in eight midcontinent and southeastern states.

License territory includes Arkansas, Oklahoma, New Mexico, Texas, Louisiana, Mississippi and Alabama and that part of Florida lying west of the Apalachicola River.

'44 B. M. Yearbook Available

WASHINGTON—Bureau of Mines' 1944 edition of Minerals Yearbook, containing one chapter on crude petroleum and petroleum products, is now available for public distribution and can be obtained for $3 each from Documents Superintendent, Government Printing Office, Washington, D. C. Chapter on petroleum can be purchased separately for 20c.

This EMBLEM

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Jobbers and dealers alike long have profited by the sales-value of the emblem of the Pennsylvania Grade Crude Oil Association. It has been, it always will be, a steady builder of business in lubricating oil.

There are two major reasons for the sales-value of this famous emblem: 1—the quality of the motor oils entitled to use it; 2—the persuasive and consistent advertising the Association has put behind it for 22 consecutive years.

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- ★ Aviation Gasoline, Naphtha and Fuel Oil Tank Wagon Prices
- ★ Crude oil prices from all fields
- ★ Statistics and graphs on production and stocks of crude oil and principal refined products
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- ★ A day-by-day price history of all petroleum products for 1945
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Drop 5-Year Cylinder Tests, Butane-Propane Assn. Asks

NPN News Bureau

CHICAGO — National Butane-Propane Assn's. quarterly sessions of Executive Committee and board of directors held here May 23-24, called for immediate steps toward elimination of ICC rule requiring cylinder tests every 5 years. Method by which this matter is to be approached was left to officers of the association.

Plans were laid for its annual convention here at Continental Hotel, September 23-25, with exhibits to be maintained in Boulevard and Tropical rooms with first choice of exhibit space going to association members.

Inability of many directors to be present because of railroad strike caused final action on a number of proposals to be held up pending contact with those absent.

° ° °

MINNEAPOLIS — Second district meeting of National Butane-Propane Assn. will be held at Hotel Texas, Fort Worth, Monday, June 10, commencing 10:00 a. m., according to bulletin by Elwin E. Hadlick, executive vice president.

This meeting will precede annual convention of Texas Butane Dealers Assn., which will be held at the same hotel June 11-12.

J. Richard Verkamp, Verkamp Corp., Cincinnati, president of NBPA, will preside and tell of aims and purposes of the organization.

W. E. Fraley, Fraley & Co., Abilene, Tex., association's secretary and president of Texas Butane Dealers Assn., will address meeting as will Mr. Hadlick, executive vice president of NBPA, Minneapolis. C. R. Bailey, National LPC Institute, Tulsa, will also speak.

Ashland Oil & Refining Co. Buys Star Gas, Lexington

Special to NPN

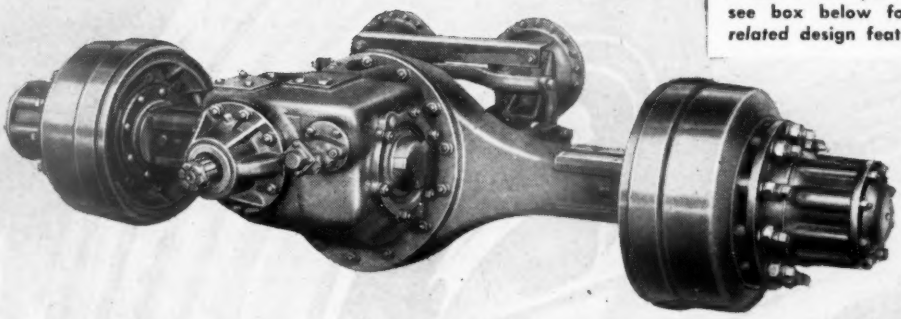
ASHLAND, Ky. — Ashland Oil & Refining Co. has purchased Star Gas & Oil Co., independent distributing organization of Lexington, Ky. Purchase price was not disclosed.

Facilities purchased include seven owned or leased stations, 25 dealer outlets and a bulk plant. All are in a 50-mile area of Lexington. Company officials said the deal was in line with Ashland's expanding marketing operations program now under way.

Reschedule API Board Meeting

NEW YORK — API board of directors meeting originally scheduled for May 28-29, and cancelled because of the railroad strike, has now been called by President Boyd for Tuesday, June 25, at 10 a.m. at Adolphus Hotel, Dallas. Board will continue in session until docket is cleared.

Mr. Boyd urged members to make hotel reservations promptly.



Timken Two-Speed Double-Reduction Axles are the most modern two-speeds in production today. S and U Heavy-Duty Series illustrated at left—see box below for partial list of *advanced-related* design features.

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...FAR AND FAST...IN EITHER SPEED!

NEW TIMKEN S and U 300 Series Two-Speed Double-Reduction Axles offer EVERY MODERN FEATURE!

- Combines for the first time advantages of hypoid-bevel gearing with those of helical spur gearing.
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- Built-in shift mechanism—lubricated by gear lubricant.
- Single-speed final drive of S and U 200 and two-speed final drive of S and U 300 are interchangeable in same axle housing using same axle shafts.
- New housing design gives uniform distribution of load stresses with minimum weight.
- New differential with 9-16 tooth combination.
- New shaft design eliminates failures at splines.
- Sixteen slant-sided axle shaft splines with increased root diameter permits maximum shaft diameter.
- New "DP" Heavy-Duty Hydraulic Brake (only **true** heavy-duty hydraulic made today) and famous "P" Series Power Brake are interchangeable.
- New transfer bar hook-up for "P" Series Brakes—protected location for brake chambers.
- For heavy-duty hauling on and off the road where permissible loads are over 18,000 pounds at the tires on the ground.
- IN FULL PRODUCTION NOW!

Gear train of S and U 300 Series. Note new hypoid-bevel gears — big, husky helical gears. Timken tapered roller bearings are adjustable.

THEY'RE *TRUE* TWO-SPEED AXLES

You don't have to baby Timken Two-Speed Double-Reduction Axles.

If you want to haul something somewhere in *low speed,* you go ahead and haul it—as far as you want, as fast as you want. You can highball in low range all the way across Texas if you need to, without your Timken Two-Speed working up even a boy-size sweat.

And the same thing goes for the high range.

With a Timken, *you* call the tune. *You* say which gear ratio you want to use and how long you want to use it, instead of the axle telling you.

Remember this the next time you need a two-speed axle and want a *TRUE* two-speed.

But there's more to the story than this. For example, Timken two-speed gear ratios were *selected* to meet present-day conditions and demands, instead of the fundamental design of the axle dictating what ratios could be offered. Therefore, as conditions and demands change in the future, Timken ratios can change with them *— and will!*

Another thing is that Timken Two-Speed Double-Reduction Axles provide up to two inches more ground clearance. So, if you operate "two-speed" off the pavement, here's still another reason to specify Timken.

There are scores of other Timken two-speed features. Write for a copy of our new folder—or ask your Timken Field Man the next time he calls. You'll find it worth your while.

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California Research To Expand Facilities

Special to NPN

SAN FRANCISCO — Approximately $2,000,000 will be spent for expansion of California Research Corp. laboratories at Richmond, Calif., under plans now being worked out here.

Laboratories, working for Standard Oil Co. of California, will soon double their present space. A new process laboratory and pilot plant building, costing more than $1,000,000, is in the design stage. This structure will centralize research facilities now housed in a number of smaller buildings and is particularly planned for erection of non-permanent pilot plants and other heavy equipment.

Company's laboratories at El Segundo will have office space in a new building and additional laboratories may be built later.

Standard also will modernize its Richmond, Calif., refinery wharfing facilities at a cost of $4,370,000, following approval of project by CPA.

When program is completed, reconstructed wharf is expected to rate among best of its kind. Plans include truck causeway, enlargement of pier to increase docking space from present three deep-water berths to five and to provide space for 6 barges, and reconstruction of repair dock, office building, machine shop and warehouse. Loading section will be lengthened from present 1516 feet to 2466 feet. A mile-long, two-lane causeway of reinforced concrete with asphaltic surface will connect wharf to shore.

WPRA Regional Technical Meet Set at Lansing Mich., June 20

NPN News Bureau

TULSA — Western Petroleum Refiners Assn. will hold its second postwar regional technical meeting at Olds Hotel, Lansing, Mich., June 20 at 2:30 p. m.

Two topics of special interest to refiners located in the Michigan and northern area will be discussed at the session. Discussion will follow presentation of each paper.

"Refinery Waste Disposal" will be discussed by L. C. Burroughs, Shell Oil Co. Water treating problems and prevention of scale formation in cooling equipment will be discussed in a paper to be presented by Dearborn Chemical Corp. Speaker will be announced later.

Army Scientific Personnel May Apply for Discharge

NPN News Bureau

WASHINGTON—Army personnel with scientific or technical skills which are not being utilized by the Army and cannot be utilized by reassignment within their commands may—by meeting certain requirements—apply for discharge or relief from active duty to enter civilian laboratories or to study, teach or engage in scholastic research.

War Department Circular 363, dated last Dec. 6, sets forth that anyone in the Army in such a category may seek discharge under the provisions of Paragraph 3, AR 615-365 or relief from active duty under the provisions of Section III, WD Circular 290, 1945, provided he:

1. Possesses a bachelor's degree in a physical science or in engineering from an accredited college or university, and

2. Has been accepted as a graduate student, or a teacher, in an accredited college or university to study, teach, or engage in research in a physical science and signifies intention to pursue such work, or,

3. Has been accepted for a position to engage in research in a physical science in a reputable civilian scientific laboratory and signifies intention to pursue such work.

Applications must include documentary evidence that the conditions specified have been fulfilled.

Applications will be forwarded through channels to commanders specified in Paragraph 6, AR 615-360, in the case of enlisted personnel, and commanders specified in WD Circular 290, 1945, as amended, in case of officer personnel.

Headquarters through which an application passes that has specific knowledge of the facts will include in its indorsement a statement that the individual submitting the application "is, or has been," engaged in a scienific research project and that his scientific or technical skill is, or is not, being utilized in his present assignment.

The documentary evidence submitted must prove conclusively that the specified conditions have been fulfilled. For the purposes of the applications, the physical sciences are defined as Physics, Chemistry, Mathematics, Geology, Meteorology and Astronomy.

Builds Storage Tanks

Special to NPN

CARSON CITY, Mich.—Crystal Refining Co., has begun construction here on four 5,000-bbl. storage tanks costing approximately $20,000.

Company official stated that they expect this additional storage to be ready by August and eventually company plans to use additional space for naphtha storage.

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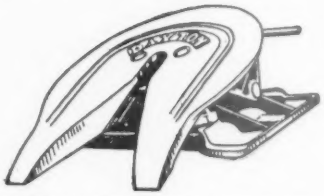

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Equipment Manufacturers Granted 10% Price Boost

NPN News Bureau

WASHINGTON — Manufacturers of oil field drilling and producing equipment have been authorized by OPA to raise maximum prices fixed at Oct. 1, 1941, or March 31, 1942, levels by 10%, effective May 31.

Increase applies also to water drilling machines and equipment, but does not include drill pipe, casing, engines, and tanks. Resellers, such as oilfield supply houses, will be permitted to pass along increase.

OPA said action was necessary to relieve many manufacturers from hardship resulting from increased materials and wage costs since 1941, and was based on study of recent individual company applications for price increases to cover higher manufacturing costs.

Agency reported that increase would provide only minimum amount required to relieve hardship, and further study to determine need of another adjustment may be needed later after additional data and figures have been obtained.

Increase is same as that granted previously to manufacturers of contraction equipment, nearest comparable industry. Action was taken in Order 638 to RMPR 136, effective May 31.

Crude Output Shows Increase In 3 Northern Mexico Fields

NPN News Bureau

WASHINGTON—Commerce Department reports that crude production in Mexico's three northern fields—Poza Rica, Naranjos and Panuco — reached average of 111,452 b/d in March, compared with 108,228 in February and 97,991 in January.

Total production for month in these three fields was 3,455,021 bbls., the Department stated, while February output was 3,030,183 bbls., and January production was 3,037,724.

Commerce also made following other foreign petroleum reports:

Canada—Petroleum products exports during January and February were valued at $498,000 (Canadian currency), compared with $1,259,000 during same period of 1945.

War Department's May report on industrial conditions in Germany, Japan and Korea last week showed German crude oil output for February, all from British zone, to have been 49,015 tons, a daily rate of 1,751 tons compared with 1,746 tons in January.

Japanese refinery operations in early February still were lagging behind crude production despite a 100% increase in output over the four weeks immediately preceding, while lead output continued low but was expected to increase materially during the month.

In Korea, a petroleum distribution system was started.

Venezuela — April petroleum production in Venezuela, Commerce Department reports, continued "well over 1,000,000 b/d during the month and output is expected to remain at its present level for the remainder of the year."

Trinidad, B. W. I.—Crude oil production figures from 1939 to 1944, which had been withheld for security reasons, were recently reported as follows: 1939—19,741,616 bbls.; 1940 — 22,226,876; 1941—20,505,980; 1942 — 22,069,178; 1943 — 21,385,240; 1944—21,634,965.

No Early Action by Senate On Tidelands Issue Foreseen

NPN News Bureau

WASHINGTON—Prospects for early consideration by Senate of tidelands quitclaim resolution (H.J. Res. 225) appear none too bright, with members hoping to adjourn by Aug. 1.

Senate Majority Leader Barkley (D., Ky.) promised that every effort would be made to obtain consideration of tidelands resolution, but that other matters had to come first.

Tentative Program Completed For API Pittsburgh Meeting

Special to NPN

PITTSBURGH—The following tentative program for the spring meeting of API's Production Division at Hotel William Penn here June 13-14 has been completed:

Thursday, June 13

8 a.m.—Breakfast meeting for presiding officers, authors and discussers, Suite 568, Hotel William Penn.

9:30 a.m.—Morning session: Presiding, Virgil F. Bowyer, Peoples Natural Gas Co., Pittsburgh and district chairman of Eastern Section, API Production Division. Address of Welcome by Mayor David L. Lawrence; response by Mr. Bowyer.

"Federal Power Hearings in the Natural Gas Industry," by E. Holley Poe of E. Holley Poe and Associates, New York.

"Problems We Face Today," by Walter S. Hallanan, president Plymouth Oil Co., Pittsburgh.

"Construction of Tennessee Gas and Transmission Line," a technicolor picture, courtesy of Chicago Corp.

2 p.m.—Afternoon session: Presiding, Kurt H. Adresen, South Penn Oil Co., Bradford, Pa. (For afternoon session see NPN May 29, p. 12.)

7 p.m.—Banquet and entertainment.

Friday, June 14

9:40 a.m.—Morning session: Presiding, R. B. Anderson, assistant superintendent, Columbia Carbon Co., Charleston, W. Va.

"Oil and Gas Possibilities in the Appalachian Region with Emphasis on New York," by Dr. E. T. Heck, geologist, New York State Museum, Albany, N. Y.

"Safety in the Oil and Gas Fields," by Paul Walton, chief engineer, Industrial Gas Corp., Newark, O.

"Oil Economics," by H. M. McClure, independent producer, Alma, Mich.

Business session: Presiding Mr. Bowyer. Reports of Michigan, Illinois Basin chapters and nominating committee and election of officers.

2 p.m.—Afternoon session: Presiding, Gordon Gulley, geologist, Gulf Oil Corp., Pittsburgh.

"Marble Shooting," by J. Gordon Burch, Burch Agate Torpedo, Borger, Tex.

"Reconditioning of Drowned Gas Wells," by Dr. S. T. Yuster, associate professor, Pennsylvania State College.

"Deep Rotary Drilling in Appalachian Region," by Bruce Miller, drilling superintendent, Ohio Oil Co., Findlay, O.

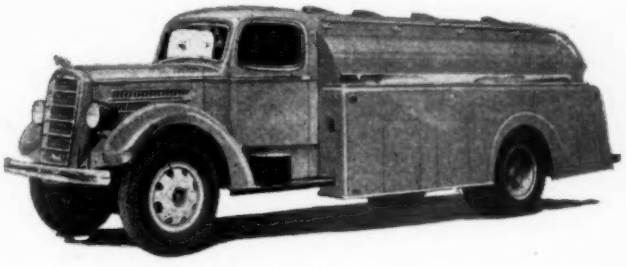
"Deep Cable Tool Drilling in Appalachian Region," by Harold W. Haupt, vice president of Acme Drilling Co., Greensburg, Pa.

Half a Century of Truck Progress... A PICTURE HISTORY

1906 The first Mack commercial gasoline vehicle was delivered in **1900**. It operated as a bus and later as a truck for 17 years. By 1906, the automotive industry's tenth birthday, Mack trucks had many advanced features, including the "high cab" (above), granddaddy of today's cab-over-engine design.

1916 Ten years later came the famous AC "bulldog" model which made the phrase "built like a Mack truck" a popular synonym for rugged strength. You can still see many of these trucks grinding along through city streets, steadfastly making money for their owners and looking quite at home in modern traffic.

1926 More powerful engines were being used, and by 1926 pneumatic tires were fast displacing solids and making possible greater road speeds. These progressive trends, plus certain exclusive refinements of Mack engineering, were embodied in the Mack AB.



1936 An important milestone in truck history was the introduction, in 1936, of the now widely-used Mack EH—a model which surpassed anything previously attained in truck performance.

1946 Today, with World War II experience crowning its 46 years of production, Mack again takes the lead in building the world's hardest-working trucks . . . *trucks which set industry standards for stamina, performance, economy and long life.*

The Automotive Industry's 50th Anniversary is Mack's 46th

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PERFORMANCE COUNTS!

Oil Trucker Granted Wis. Route Extension

NPN News Bureau

WASHINGTON — Over protests of railroads and four railway labor brotherhoods, ICC has granted Petroleum Transport, Inc., of Madison, Wis., authority to extend its motor truck routes as common carrier of petroleum products in Illinois, Indiana and Wisconsin.

In announcing decision, ICC said, "motor transportation of petroleum products possesses certain inherent advantages over rail transportation. There are dealers in petroleum products in the considered Wisconsin territory which cannot be served adequately by rail carriers because they do not have storage facilities to accommodate carload lots and because some are remote from any rail service."

Commission specifically granted permission for trucking firm to transport oil products to bulk plants only in certain sections of Wisconsin from origin points in Illinois, including part of Chicago commercial zone, and Indiana. Trucking company was supported by representatives of Pure Oil, Phillips Petroleum, Cities Service and secretary of Wisconsin Petroleum Assn., ICC said.

Review of recent petroleum transportation activities in Wisconsin was made in ICC decision, which noted that in May, 1943 the state modified 1929 statute prohibiting truck loads in excess of 2,000 gals. Present law sets no gallonage limit but has provision that, effective six months after termination of war, loads in excess of 2,000 gals, can be carried only to bulk plants or consumer terminals.

ICC cited ODT directive, still in effect, prohibiting tank car shipments of oil products of less than 200 miles, except when special authority is granted. Railroads operating in Wisconsin area affected by ICC decision, contended there would be no need for both rail and motor facilities when ODT directive is revoked.

In another order, ICC set hearing for June 24 at 641 Washington St., New York City, on application of D. E. Burner and Fuel Corp., Rockville Center, L. I., N. Y., to transport petroleum products between New York City and certain points in New Jersey and New York.

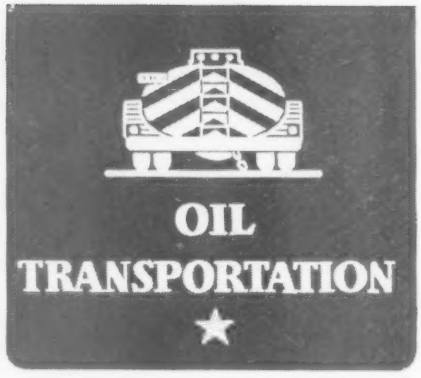
Hearing Dates Are Scheduled On Oil Trucking Applications

NPN News Bureau

WASHINGTON—ICC has set the following dates on applications of motor trucking firms to extend routes in transportation of petroleum products in bulk and in tank trucks:

June 18 at Federal Bldg., in Terre Haute, Ind.—Applications of Refiners Transport, Inc., Indianapolis, Ind., for permission to operate from Mt. Vernon, Ind., to points in Gallatin, Hardin, Saline, Wabash and White Counties of Illinois.

June 19 at State Railroad and Warehouse Commission Bldg., St. Paul, Minn.—Application of Mondovi Trucking Co., for authority to operate from Minneapolis, St. Paul, New Brighton and Winona, Minn., to points in Barron, Buffalo, Chippewa, Funn, Eau Claire, Pepin, Pierce, Polk, Rusk, St. Croix and Trempealeau Counties in Wisconsin.



Trans-Continental Gas Capital Stock Increased to $120,000

Special to NPN

AUSTIN—Records in the office of the Secretary of State here show that the Trans-Continental Gas Pipeline Co., which proposes to buy Big and Little Inch lines, has increased its capital stock from $1000 to $120,000.

Subscribers to the additional stock, revealed in a charter amendment, are: Rogers Lacy of Longview, $35,000; H. W. Bass of Dallas, $1,190; Cox and Hamon of Dallas, $5950; Bert Fields of Dallas, $5950; S. N. Van Wert of Dallas, $5950; Corpus Christi Corp., $17,850; A. C. Glassell of Shreveport, $8330; and M. T. Flanagan of Longview, $5950.

Directors are Messrs. Lacy, Glassell, Fields and C. C. Small of Austin, attorney for The Chicago Corporation, which owns extensive gas reserves in the Carthage Field near the Longview terminal of Big Inch, as well as in South Texas.

Bid Deadline Is Set

WASHINGTON—June 14, 4 p.m., is set by WAA as shut-off date for bids on transmission systems of "Big Inch" and "Little Big Inch" pipelines. Facilities will be sold in place to power companies. No closing date has been set for bids on pipelines themselves.

Texas-New Mexico Co. to Build 475-Mile 16-Inch Oil Pipeline

Special to NPN

HOUSTON—Texas-New Mexico Pipe Line Co. of Houston plans to construct 16-inch oil pipeline from Crane in West Texas to Houston, a distance of 475 miles. Cost is estimated at $12,000,000.

Company officials said construction will not start until 1947 due to the materials shortage, particularly in pipe. Line will parallel present 12-inch line to Houston, which is now running sour crude to Gulf Coast terminals.

The Texas Co. has a 45% interest in the pipeline company and remainder is owned by Sinclair, Tide Water and Cities Service.

When completed big line will run sour crude and the smaller carrier will revert to sweet crude. Terminus of new line will be big tank farm of The Texas Co. southeast of Houston.

Sinclair interests will pick up its share of oil at the Houston terminal, using part of it at its Sinco Refinery at Pasadena (near Houston). Tide Water will also pick up its share at Houston for tanker shipment to its refinery at Bayonne, N. J. Cities Service will pick up its share of oil at Sour Lake, near Beaumont, and run it to refinery at Lake Charles, La. The Texas Co. will run its portion through its present pipeline from Houston to its refinery at Port Arthur.

Capacity of new line will depend on load requirements, and booster pumps may be added as needed. Present line has a capacity of about 60,000 b/d.

Truck Fleet Training Course Offered by Ohio State U.

Special to NPN

COLUMBUS, O.—Ohio State University is offering again this year a one-week course in selecting, training and supervising truck fleet personnel. Course is designed for supervisors of bus and truck fleets throughout the state.

Similar courses are given annually in more than 20 states, on a schedule that permits the national sponsoring agencies to supply a part of the instructional staff at each school. Remainder of the staff for the Ohio course is now in process of selection by an advisory board comprising representatives of state agencies and private fleets. Board members include:

Sgt. H. W. Anderson, Columbus; S. T. Dondy, Cincinnati; Don Finkbeiner, Toledo; Horace I. Gwilym, Cleveland; Frank Kirby, Columbus; J. Russell Lloyd, Columbus; C. E. MacQuigg, Columbus; Harry E. Neal, Columbus; Prof. H. E. Nold, Columbus; A. H. Polk, Dayton; Harry M. Pontious, Columbus; Capt. Paul Price, Dayton; C. J. Randall, Ralph Riley, Prof. C. P. Roberts, Charles D. Vibberts and C. E. Wallingford, all of Columbus.

Although formal registration doesn't open until August, a number of reservations already are on file at the university. Indications are that a capacity enrollment will be reached. Additional information pertaining to the course can be obtained from any of the board members or from Don Johnstone, director, Motor Vehicle Fleet Supervisors Short Course, Brown Hall, Ohio State University, Columbus.

Plywood Barge Report Made

NPN News Bureau

WASHINGTON — A sectionalized plywood barge, designed for the Army during the war, proved satisfactory for transporting petroleum products in rivers, harbors or along coastal shore lines, according to report released by Commerce Department. Report, made by staff of Army's Engineer Board, describes construction, operation and results of experiments with this type of barge.

Reports available at Office of Publication Board, Commerce Department, Washington 25, D. C.

How Successful
Was Your Spring Clean-up Campaign?

You held meetings, made demonstrations, showed films, wrote letters, developed posters and talked and talked with your men about the why and how of clean service stations.

Now, with Decoration Day here and the Fourth of July just around the corner . . . and peacetime motorists on the go . . . are your stations really ready?

Here's a quick way to find out—*for sure*!

Give each one of your station managers the handy Service Station Inspection Booklet published by NPN especially for "cleaning-up service stations to bring in more business" . . . then check his station with him.

This pocket-size Inspection Booklet covers every part of a Service Station—Signs and Lighting . . . Driveways and Lawns . . . Building Exteriors . . . Pump Islands . . . Building Interior . . . Rest Rooms . . . Lubritorium . . . Heating System . . . Personnel.

The booklet is divided into sections—each section has a few clear, easy-to-understand *important* questions that really put the finger on those places where customers are won or lost . . . Here are a few samples:

* ***Have all dirty, out-of-date or unauthorized signs and advertisements been removed?***
* ***Is the pump island free of waste rags and paper?***
* ***Are water buckets, windshield service equipment in place and clean?***
* ***Are operator's uniforms clean?***

An easy-to-use Scoring Table in the back of the booklet also shows station managers how their stations rate on housekeeping.

These handy Service Station Inspection Booklets will not only give you a check on the results of your spring house-cleaning campaign . . . they will also help get the "undone" things done, thoroughly and quickly.

To enable you to supply all of your station managers with Inspection Booklets, at reasonable cost, here are attractive low quantity prices:

Single copies	$0.25	200 copies	$32.00
25 copies	5.50	500 copies	70.00
50 copies	10.00	1000 copies	130.00
100 copies	18.00	Prices for larger quantities on request	

Quantities other than those shown above will be billed at the per copy rate for the next smaller quantity shown.

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Use the convenient coupon below to order your supply of booklets, or your company order blank, if you prefer.

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COMPANY .....

ADDRESS .....

CITY ..... ZONE ..... STATE .....

NOTE: Many oil companies are using the Service Station Inspection Booklet as a basis for a continuous program of good station housekeeping. Your experience in using it as an audit of the results of your spring house-cleaning campaign will help you decide whether you want to carry on a similar program.

Standard Oil of California Boosts Avgas Octane Rating

Special to NPN

SAN FRANCISCO—Standard Oil Co. of California is now offering Chevron aviation gasoline 80 octane, at main points in its marketing territory, and coincident with receipt of stocks of the new grade at bulk plants the company's former grade —Chevron aviation 73 octane—has been discontinued.

Standard's new aviation gasoline is unleaded, and prices at main points are one cent above recent postings for Chevron aviation 73. Tank truck prices, ex-taxes, posted by Standard for Chevron aviation 80, together with effective dates, are:

	Chevron Aviation 80 Octane Cents	Effective Date
San Francisco	13.5	5/ 7/46
Los Angeles	13	5/ 7/46
Fresno, Calif.	14.5	5/ 7/46
Phoenix, Ariz.	15.5	5/ 7/46
Reno, Nev.	15.5	5/ 7/46
Portland, Ore.	14	5/20/46
Seattle, Wash.	14	5/31/46
Spokane, Wash.	17	5/31/46
Tacoma, Wash.	14	5/31/46
Boise, Idaho	17	5/20/46

Deaths

Guy Runyan, 48, president of the National Assn. of Petroleum Retailers, died May 23 at his home in Ames, Iowa, of a heart attack.

Mr. Runyan owned a super-service station in Ames.

Oil Markets

WESTERN PENNA. — Regular-grade gasoline was up 0.25c to 7.25c in the upper Western Penna. field and several lower field refiners also reported increased quotations in the week ended June 1. Prices for other products for the most part were reported unchanged.

Pick-up in demand for Ethyl gasoline was indicated in reports of most refiners. Jobbers, refiners said, were endeavoring to fill storage with as high octane material as possible before further downward revision in maximum octane rating for Ethyl is made by CPA. Shipments of regular-grade also were heavy, according to most refiners, although some indicated their shipments were "only normal for the season."

Two upper field refiners offered regular-grade gasoline at 7.25c per gal. Lower field quotations ranged from 6.75 to 7.25c with one refiner quoting 6.75c, three refiners 7c, and four refiners 7.25c.

Kerosine and fuel oils were steady. Lubricating oils, petrolatums and wax remained tight, with most refiners sold up for two to three months.

° ° °

GULF COAST—Little change in the general market situation at the Gulf was indicated in reports in New York and from the Southwest the past week. Prices were reported firm for all products with the possible exception of Ethyl gasoline.

Inquiry for regular-grade gasoline was active throughout the week and supplies were said to be closely held at ceiling price of 5.75c per gal. There was increased reluctance on the part of sellers to quote a flat price for forward delivery. Most suppliers were holding for "market date of lifting", with some refusing to offer at other than their own posted prices on date of lifting.

A cargo of Ethyl gasoline was said to have sold at 6.25c the past week but confirmation was lacking. While the opinion was expressed in some quarters that 6.25c might be done on firm offer, suppliers generally were asking 6.375c and up. Buyers showed little interest in Ethyl at this price.

Recent purchasing by the Army for possible June lifting was made known the past week as follows: Two cargoes of kerosine,—one at 4.625c, FOB U. S. Gulf, and one at 4.625c, FOB Caribbean area; and two cars of 72 oct. motor gasoline at 5.5c, FOB Caribbean area.

Kerosine and No. 2 fuel also were closely held by Gulf suppliers and there was no indication that current ceiling prices were being shaded. Heavy fuels were "unobtainable in the open market," according to most reports.

° ° °

ATLANTIC COAST—Ideal motoring weather with the first hot spell of the season brought record breaking gasoline consumption along the eastern seaboard in the short Memorial holiday week. Prices generally were reported unchanged but many suppliers said they were contemplating price increases if the demand continues heavy.

The call for gasoline in the northern seaboard areas was further stimulated by the threatened strike of maritime workers about mid-June. Barge buyers were filling their tanks in the event the strike materializes, suppliers said.

At New York, Philadelphia and Baltimore, one supplier continued to offer reg-

CRUDE PRICES

Since changes in crude oil prices are infrequent, the two pages of crude oil price tables are printed only when there are sufficient changes to warrant.

A record is kept in the Cleveland office of NPN and OILGRAM from which the publishers will be glad to make proofs, or letters or affidavits as to what the prices are, and without charge to regular subscribers.

Crude Price Changes

No price changes for week ending May 29.

For latest table of crude prices published, see NPN May 29, pages 44, 45 and 47.

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Time—Right after the first mail comes in
Characters—The Boss and his immediate assistants

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ular-grade gasoline at 6.25c tank cars, 6.15c barges, and a barge-lot sale was reported at 6.15c in the Philadelphia district. Quotations reported by other suppliers ranged up to 8c tank cars, 7.6c barges at New York; 7.7c tank cars, 6.9c barges at Philadelphia; and 7.45c tank cars, 6.9c barges at Baltimore. Barge-lot sales also were reported as follows: 6.75c New York, 6.65c Philadelphia, and 6.5c Baltimore.

Buyers were showing increased interest in making kerosine and light fuel commitments for the next heating season, and were endeavoring to obtain supplies on the basis of concessions "under the market" at time of lifting. Suppliers in most instances, however, were refusing to shade prices, many of them holding to "market price date of lifting, take it or leave it." Some industrial users were said to be using No. 2 fuel in place of heavy fuel due to extreme scarcity of the latter.

° ° °

MID-WESTERN — Gasoline prices continued recent upward trend in the Midwest the past week with quotations reported by refiners up 0.25c for Ethyl, 0.125c for other grades. Marketers' quotations also were higher, and there was considerable speculation among the trade over possibility of an advance in tank wagon prices in Standard of Indiana territory.

Group 3 gasoline quotations reported by refiners ranged from 6.5 to 6.75c for Ethyl as the short holiday week ended, 5.625 to 6c for 73-75 oct. regular, 5 to 5.25c for 60 oct and below, and one refiner offered 63-66 oct. at 5.375c. One refiner reported open spot sales of 12 cars of Ethyl at 6.375c and 6.5c, 12 cars of regular at 5.5c and 5.625c, and 3 cars of 60 oct. and below at 4.875c and 5c.

Marketers' gasoline quotations, FOB Group 3 basis, ranged from 6 to 6.625c for Ethyl, 5.5 to 5.625c for regular, and 4.75 to 5c for 60 oct. and below.

Although marketers reported the gasoline market "dull," they said there was considerable interest in heating oils. Early in the week a marketer reported selling 6 cars of No. 2 straw at 4.125c and another said he had sold "several cars" at same price. Some marketers offered No. 2 fuel at 4c, six refiners quoted 4.125c.

Good kerosine sales volume was reported by one refiner who offered 41-43 at 4.75c, 42-44 at 4.875c; other refiners quoted 4.875c and 5c, Group 3, for the two grades, respectively, and most of them said they preferred to fill storage for the next heating season rather than to sell below ceiling prices now.

° ° °

CENTRAL MICHIGAN — Gasoline shipments continued heavy from Central Michigan plants in the week ended June 1. Some refiners said they were contemplating advancing their quotations following a 0.25c advance in Detroit terminal tank car quotations to 7.25c for regular, 8.25c for Ethyl. Refiners' quotations for the two grades, respectively, ranged from 7 to 8.25c and 8 to 9.25c, FOB Central Michigan.

Although several refiners said they were short of kerosine, one refiner lowered his price for 46-49 W. W. from 6.5 to 6.25c, effecting a 0.05c drop in low quotations. Gas oils were in good demand throughout the week and residual production continued to fall short of demand, according to reports.

° ° °

MIDCONTINENT — Gasoline prices advanced in the Midcontinent again the past week with increases ranging from 0.125 to 0.5c per gal. Demand, mainly against contracts, continued heavy. No open spot sales to jobbers were reported.

Gasoline prices reported by Oklahoma refiners at the end of the week ranged from 6.5 to 6.75c for 78-80 oct. Ethyl, 5.75 to 6c for 73-75 oct. regular, 5 to 5.25c for 60 oct. and below, and one refiner quoted 5.5c for 63-66 oct.

One-hundred car sale of regular-grade gasoline at 6c, FOB North Texas, to another refiner for delivery over first part of June was reported by a North Texas refiner. This refiner said his gasoline shipments thus far in May were up 25% over April whereas in past he had anticipated only 15% increase in May over April.

Neutrals demand also continued heavy in the Midcontinent, according to reports of refiners. Low quotations for 250 vis. and 280 vis. Pale oils were up 0.5c with prices ranging from 15 to 16c, and 15 to 16.5c, for the two grades, respectively.

Open spot sales of 4 cars of Grades 26-70 natural gasoline were reported at 3 to 3.25c, Group 3, during the week; 13 cars were reported sold open spot at 2.5c and 6 cars at 2.75c, Breckenridge.

Summary of Daily Gasoline Prices (May 27 to June 3)

U. S. Motor (ASTM octane)	Monday June 3	Friday May 31	Wednesday May 29	Tuesday May 28
78-80 octane Ethyl:				
Oklahoma	6.5-6.75	6.5-6.75	6.375-6.75	6.375-6.75
Mid-Western (Group 3 basis)	6.5-6.75	6.5-6.75	6.325-6.75	6.375-6.75
N. Tex. (For shpt. to Tex. & N. M. dest'ns.)	7	7	7	7
W. Tex. (For shpt. to Tex. & N. M. dest'ns.)	7	7	7	7
E. Tex. (Truck Tnsp.)	7	7	7	7
73-75 octane:				
Oklahoma	5.75-6	5.75-6	5.625-6	5.625-6
Mid-Western (Group 3 basis)	5.625-6	5.625-6	5.5-6	5.5-6
N. Tex. (For shpt. to Tex. & N. M. dest'ns.)	6	6	6	6
W. Tex. (For shpt. to Tex. & N. M. dest'ns.)	6	6	6	6
E. Tex. (Truck Tnsp.)	6	6	6	6
63-66 octane:				
Oklahoma	5.5(1)	5.5(1)	5.375(1)	5.375(1)
Mid-Western (Group 3 basis)	5.375(1)	5.375(1)	5.25(1)	5.25(1)
N. Tex. (For shpt. to Tex. & N. M. dest'ns.)	5.625(1)	5.625(1)	5.625(1)	5.625(1)
W. Tex. (For shpt. to Tex. & N. M. dest'ns.)	5.625(2)	5.625(2)	5.625(2)	5.625(2)
E. Tex. (Truck Tnsp.)	....	....	....	....
60 octane & below:				
Oklahoma	5.125-5.25	5.125-5.25	5-5.25	5-5.25
Mid-Western (Group 3 basis)	5-5.25	5-5.25	4.875-5.25	4.875-5.25
N. Tex. (For shpt. to Tex. & N. M. dest'ns.)	5.2-5.25	5.2-5.25	5.2-5.25	5.2-5.25
W. Tex. (For shpt. to Tex. & N. M. dest'ns.)	5.25	5.25	5.25	5.25
E. Tex. (Truck Tnsp.)	5.25	5.25	5.25	5.25
Motor Gasoline, 78-80 oct. (Ethyl)				
New York harbor	7.25-8.95	7.25-8.95	7.25-8.95	7.25-8.95
New York harbor, barges	7.15-7.9	7.15-7.9	7.15-7.9	7.15-7.9
Philadelphia	7.25-8.95	7.25-8.95	7.25-8.95	7.25-8.95
Philadelphia, barges	7.15-7.9	7.15-7.9	7.15-7.9	7.15-7.9
Baltimore	7.25-8.7	7.25-8.7	7.25-8.7	7.25-8.7
Baltimore, barges	7.15-7.9	7.15-7.9	7.15-7.75	7.15-7.75
Motor Gasoline, 74-77 oct.				
New York harbor	6.25-8	6.25-8	6.25-8	6.25-8
New York harbor, barges	6.15-7.6	6.15-7.6	6.15-7.6	6.15-7.6
Philadelphia	6.25-7.7	6.25-7.7	6.25-7.7	6.25-7.7
Philadelphia, barges	6.15-6.9	6.15-6.9	6.15-6.9	6.15-6.9
Baltimore	6.25-7.45	6.25-7.45	6.25-7.45	6.25-7.45
Baltimore, barges	6.15-6.9	6.15-6.9	6.15-6.85	6.15-6.85
Motor Gasoline:				
Western Penna. Bradford-Warren:				
74 Oct.	7.25(2)	7.25(2)	7.25(2)	7.25(2)
Western Penna. Other Districts:				
74 Oct.	7-7.25	6.75-7.25	6.75-7.25	6.75-7.25

Note: Gasoline prices are as reported in each day's Platt's OILGRAM Daily Oil Price Service.

OIL PRICE SECTION ★ At Refineries and Terminals and by Tank Wagon

Prices herewith are reproduced from Platt's *OILGRAM* Daily Oil Price Service, associated with National Petroleum News, whose representatives in all *NPN-OILGRAM* offices devote their time exclusively to reporting oil industry prices everywhere.

Prices shown are actual sales prices, or quotations meaning sellers' general offers or posted prices; for current sales and shipment; for the business day or period stated; except Tank Wagon prices, prices are for bulk lots such as tank car and motor transport; barge or tanker cargo lot prices are identified; FOB refineries or terminals; in cents per gal. except where shown in bbls. of 42 gals.; ex all fees and taxes; for crude oil and its products lawfully produced and transported; reported as received by *OILGRAM* and National Petroleum News but not guaranteed; for subscribers' private use only and not for resale or distribution or publication. For further details of price conditions apply to any *NPN-OILGRAM* office or see back of any *OILGRAM* Price Service invoice.

For complete price service delivered daily from nearest *OILGRAM* publishing office, New York, Cleveland and Tulsa, address Platt's Price Service, Inc., 1213 W. 3rd St., Cleveland (13), Ohio. Annual subscription rate payable in advance $100 per year train mail and $112.50 per year air mail.

Refinery Prices

Gasoline —U. S. Motor (ASTM octane except where otherwise specified)

Prices in Effect	June 3	May 27
OKLAHOMA		
78-80 oct. Ethyl	6.5–6.75	6.25–6.75
73-75 oct.	5.75–6	5.5–6
63-66 oct.	5.5(1)	5.375(1)
60 oct. & belqw	5.125–5.25	5–5.25
MID-WESTERN (Group 3 basis)		
78-80 oct. Ethyl	6.5–6.75	6.25–6.75
73-75 oct.	5.625–6	5.5–6
63-66 oct.	5.375(1)	5.25(1)
60 oct. & below	5–5.25	4.875–5.25
N. TEX. (For shpt. to Tex. & N. M. dest'ns.)		
78-80 oct. Ethyl	7	7
73-75 oct.	6	6
63-66 oct.	5.625(1)	5.625(1)
60 oct. & below	5.2–5.25	5.2–5.25
W. TEX. (For shpt. to Tex. & N. M. dest'ns.)		
78-80 oct. Ethyl	7	7
73-75 oct.	6	6
63-66 oct.	5.625(2)	5.625(2)
60 oct. & below	5.25	5.25
E. TEX. (Truck Tnspt.)		
78-80 oct.	7	7
73-75 oct.	6	6
60 oct. & below	5.25	5.25
CENT. W. TEX. (Prices to truck transports)		
78-80 oct.	7(2)	7(2)
73-75 oct.	6(2)	6(2)
60 oct. & below	5.25(2)	5.25(2)
KANSAS (For Kansas destinations only)		
78-80 oct. Ethyl	6.9375–7.2	6.875–7.2
73-75 oct.	5.9375–6.2	5.875–6.2
63-66 oct.	5.6(1)	5.6(1)
60 oct. & below	5.2–5.5	5.2–5.5
ARK. (For shipment to Ark. & La.)		
78-80 oct. Ethyl	7(1)	7(1)
73-75 oct.	6(1)	6(1)
60 oct. & below unleaded	5.25(1)	5.25(1)
WESTERN PENNA.		
Bradford-Warren:		
74 oct.	7.25(2)	7–7.25(2)
Other districts:		
74 oct.	7–7.25	6.75–7.25

Prices in Effect	June 3	May '27
CENTRAL MICHIGAN (FOB Central Mich. refinery group basis; for shpt. within Mich.; shpts. may originate at plants outside Central group.)		
U.S. Motor:		
78-80 oct.	8–9.25	8–9.25
73-75 oct.	7–8.25	7–8.25
Str. run gasoline, excluding Detroit shpt.	5–6	5–6
OHIO (S. O. Ohio quotations for statewide delivery and subject to exceptions for local price disturbances.)		
73-75 oct.	8	8
CALIFORNIA		
80-82 oct. (Ethyl)	8–8.5	8–8.5
74-75 oct.	7–7.5	7–7.5

Kerosine, Gas & Fuel Oils

OKLAHOMA		
41-43 grav. w.w.	4.875	4.875
42-44 grav. w.w.	5	5
Range Oil	4.5	4.5
No. 1 p.w.	4.375	4.375
No. 1 straw	4.25(1)	4.25(1)
No. 2 straw	4.125	4.125
No. 3 fuel	4	4
No. 6 fuel	$1.11–$1.18	$1.11–$1.18
14-16 fuel	$1.18(1)	$1.18(1)
MID-WESTERN (Group 3 basis)		
41-43 grav. w.w.	4.75–4.875	4.75–4.875
42-44 grav. w.w.	4.875–5	4.875–5
Range Oil	4.5	4.5
No. 1 p.w.	4.375	4.375
No. 2 straw	4.125	4.125
No. 3	4	4
No. 6	$1.11–$1.18	$1.11–$1.18
N. TEX. (For shpt. to Tex. & N. M. dest'ns.)		
41-43 grav. w.w.	4.875	4.875
42-44 grav. w.w.	5(1)	5(1)
No. 1 p.w.	4.375(2)	4.375(2)
58 D.I.	4.55(1)	4.55(1)
No. 6 fuel	$1.18(2)	$1.18(2)
W. TEX. (For shpt. to Tex. & N. M. dest'ns.)		
No. 2 straw	4.125(1)	4.125(1)
No. 6 fuel	$1.18(1)	$1.18(1)
E. TEX. (Truck trnspt.)		
41-43 grav. w.w.	4.5–4.875	4.5–4.875
Tractor fuel	4.875–5	4.875–5
Range oil	....	....
No. 1 p.w.	....	....
45 Cet. Diesel	4.25(1)	4.25(1)
No. 2 straw	....	....
58 D.I. & above	4.5–4.75(2)	4.5–4.75(2)
No. 6 fuel	$1.18	$1.18
U.G.I. gas oil	3.5(1)	3.5(1)
AMARILLO, TEX. (For shpt. to W. Okla. & Tex. differential territory.)		
42-44 grav. w.w.	5(1)	5(1)
KANSAS (For Kansas destinations only).		
42-44 grav. w.w.	5.125–5.2	5.125–5.2
No. 1 p.w.	4.6	4.6
No. 6 fuel	$1.23	$1.23
ARK. (For shipment to Ark. and La.)		
42-44 w.w. kero.	5(1)	5(1)
No. 2	4.125(1)	4.125(1)
No. 3 fuel	4(1)	4(1)
Tractor fuel	5.5(1)	5.5(1)
Diesel fuel 52 & below	4.5(1)	4.5(1)
Diesel fuel 58 & above	4.75(1)	4.75(1)
WESTERN PENNA.		
Bradford-Warren:		
45 grav. w.w.	6.55–6.75	6.5–6.55
No. 2 "	6.25(1)	6.25(1)
No. 3 "	6.25(1)	6.25(1)
36-40 gravity	6.25(2)	6.25(2)
Other districts:		
45 grav. w.w.	6.925	6.925
47 grav. w.w.	7.05(1)	7.05(1)
No. 1 fuel	6.675–6.925	6.675–6.925
No. 2 "	6.25–6.375	6.25–6.375
No. 3 "	6.25–6.375	6.25–6.375
36-40 grav.	5.75–6.375	5.75–6.375

Prices in Effect	June 3	May 27
CENTRAL MICHIGAN (FOB Central Mich. refinery group basis for shpt. within Mich.; shpts. may originate at plants outside Central group.)		
44-46 kerosine	6.25(1)	6.25(1)
46-49 gravity w.w.	6.25–6.5	6.3–6.5
P.W. Distillate	6	6
No. 2 light straw	5.75(1)	5.75(1)
No. 3 gas oil, Straw	5.5	5.5
U.G.I. gas oil	5	5
Fuel Oils (*Vis. at* 100).		
300-500 Vis.	4.64	4.64
100-300 Vis.	5	5
OHIO (S. O. Ohio quotations for statewide delivery)		
Kerosine	7.5	7.5
CALIFORNIA		
40-43 grav. w.w.	....	....
San Joaquin Valley:		
Heavy fuel	$1.25	$1.25
Light fuel	$1.35	$1.35
Diesel fuel	4.75	4.75
Stove dist.	5.75	5.75
Los Angeles:		
Heavy fuel	$1.25	$1.25
Light fuel	$1.35	$1.35
Diesel fuel	4–4.75	4–4.75
Stove dist.	5.75	5.75
San Francisco:		
Heavy Fuel	$1.30	$1.30
Light fuel	$1.40	$1.40
Diesel fuel	5.25	5.25
Stove dist.	6.25	6.25

NOTE: All above heavy fuels meet Pacific specification 400; light fuel, spec. 300; Diesel fuels, spec. 200; and stove distillate, spec. 100.

Lubricating Oils

Prices in Effect	June 3	May 27
WESTERN PENNA.		
Prices are for sales made, or offers reliably reported, to jobbers & compounders only.		
Viscous Neutrals—*No. 3 col. Vis. at* 70° *F.*		
200 Vis. (180 at 100°) 420-425 fl.		
0 p.t.	38(1)	38(1)
10 p.t.	37(1)	37(1)
15 p.t.	36(1)	36(1)
25 p.t.	28–33	28–33
150 Vis. (143 at 100°) 400-405 fl.		
0 p.t.	36(1)	36(1)
10 p.t.	35(1)	35(1)
15 p.t.	34(1)	34(1)
25 p.t.	26–31	26–31
NOTE: Limited quantity neutrals available to regular trade.		
Cylinder Stocks:		
Brt. stk., 145-155 *vis. at* 210°, 540-550 fl., *No. 3 col.*		
10 p.t.	30.5(1)	30.5(1)
15 p.t.	29.5(1)	29.5(1)
25 p.t.	25	25
600 S.R. filterable	15	15
650 S.R.	15.5	15.5
600 fl.	16	16
630 fl.	17	17
MID-CONTINENT (F. o. b. Tulsa)		
Neutral Oils (*Vis. at* 100° *F. 0 to* 10 *P.P.*)		
Pale Oils:		
Vis. Color		
60-85—No. 2	7.5–8	7.5–8
86-110—No. 2	7.5–8.5(2)	7.5–8.5(2)
150—No. 3	12	12
180—No. 3	12.5–15	12.5–15
200—No. 3	13–15	13–15
250—No. 3	15–16.5	14.5–16.5
280—No. 3	16–16.5	15.5–16.5
300—No. 3	17–17.5(2)	17–17.5(2)
Red Oils:		
180—No. 5	12(1)	12(1)
200—No. 5	12.5(1)	12.5(1)
300—No. 5	16.5–17.5(2)	16.5–17.5(2)
Bright Stock—*Vis. at* 210°		
200 Vis. D	27(1)	27(1)
150-160 Vis. D:		
0 to 10 p.p.	23	23
10 to 25 p.p.	22.5–23	22.5–23
25 to 40 p.p.	23(1)	23(1)
150-160 Vis. E	22(1)	22(1)
120 Vis. D:		
0 to 10 p.p.	22(2)	22(2)
600 S.R. Dark Green	8.5(1)	8.5(1)
600 S.R. Olive Green	10-11(2)	10-11(2)
SOUTH TEXAS (Neutral Oils)		
Pale Oils (*Vis. at* 100° *F.*)		
Vis. Color		
100 No. 1½-2½	6.5	6.5
200 No. 2-3	8.75	8.75
300 No. 2-3	9.25	9.25
500 No. 2½-3½	10	10
750 No. 3-4	10.25	10.25
1200 No. 3-4	10.375	10.375
2000 No. 4	10.5	10.5

(Continued on next page)

NOTE—Parenthetical figures after prices indicate number of companies quoting when less than three companies are quotin

Refinery Prices—Continued

Prices in Effect	June 3	May 27
Red Oils:		
100 No. 5-6	6.5(2)	6.5(2)
200 No. 5-6	8.75	8.75
300 No. 5-6	9.25	9.25
500 No. 5-6	10	10
750 No. 5-6	10.25	10.25
1200 No. 5-6	10.375	10.375
2000 No. 5-6	10.5	10.5

CHICAGO (From Mid-Continent p.l. crude). Neutral oils *vis. at* 100° *F. 0 to* 10 *p.p.*

Pale Oils:		
Vis. Color		
60-85—No. 2	9(1)	9(1)
86-100—No. 2	9.25(1)	9.25(1)
150—No. 3	12.5(1)	12.5(1)
180—No. 3	13(1)	13(1)
200—No. 3	13(1)	13(1)
250—No. 3	14(1)	14(1)
Red Oils:		
180—No. 5	13(1)	13(1)
200—No. 5	13(1)	13(1)
250—No. 5	14(1)	14(1)
280—No. 5	15(1)	15(1)
300—No. 5	15.5(1)	15.5(1)

Note: Viscous oils, 15 to 30 p.p. are quoted 0.5c lower; 60-85 and 86-110 No. 2 non-viscous oils, 15 to 30 p.p., 0.25c lower.

Unfiltered Steam Refined (*Viscosity at* 210°)		
140	11.5(1)	11.5(1)
160	12.5(1)	12.5(1)
200	13.5(1)	13.5(1)
Bright stocks, 160 *vis. at* 210 *No.* 8 *color:*		
0 to 10 p.p.	24(1)	24(1)
15 to 25 p.p.	23.5(1)	23.5(1)
30 to 40 p.p.	21.5(1)	21.5(1)
E filtered Cyl. Stock	15.5(1)	15.5(1)

Note: To obtain prices delivered in Chicago add 0.25c per gal.

Natural Gasoline

(Group 3 & Breckenridge prices are to blenders on freight Basis shown below. Shipments may originate in any Mid-Continent manufacturing district.)

FOB GROUP 3		
Grade 26-70	3.25(Quotes)	3(Sales)
FOB BRECKENRIDGE		
Grade 26-70	2.75(Quotes)	2.5-2.75(Sale)
CALIFORNIA (FOB plants in Los Angeles basin)		
21-21.9 pound vapor pressure for blending	4.71-4.85(1)	4.71-4.85(1)

Naphthas and Solvents

(*FOB Group* 3)		
Stoddard solvent	6.5-6.625	6.5-6.625
Cleaners' naphtha	7.125	7.125
V.M.&P. naphtha	7.1-7.125	7.1-7.125
Mineral spirits	6.1-6.125	6.1-6.125
Rubber solvent	7.1-7.125	7.1-7.125
Lacquer diluent	7.375-8.125	7.375-8.125
Benzol Diluent	7.875-8.625	7.875-8.625
WESTERN PENNA.		
Other Districts:		
Untreated naphtha	7-7.25(2)	7-7.25(2)
Stoddard solvent	7.25-7.5	7.25-7.5
OHIO (S. O. quotations for statewide delivery): V.M.&P. naphtha. D.C. naphtha, Varnolene &		
Sohio solvent	9.5	9.5
Rubber solvent	9	9
E. TEXAS (Truck Tnspt.)		
Stoddard Solvent	7	7

Wax

WESTERN PENNA. (Bbls. C.L.)		
White Crude Scale:		
122-124 A.m.p.	4.25(2)	4.25(2)
124-126 A.m.p.	4.25	4.25
MID-CONTINENT (C.L. FOB Refinery)		
Semi-refined:		
132-134 AMP, bbls.	5.25(1)	5.25(1)

CHICAGO (FOB Chicago district refinery of one refiner, in bags, carloads. Carloads, slabs loose, 0.4c less. Melting points are EMP (ASTM) methods; add 3° to convert into AMP.)

Fully refined:		
122-124 (bags only)	5.6	5.6
125-127	6	6
127-129	6.25	6.25
130-132	6.55	6.55
132-134	6.8	6.8
135-137	7.55	7.55

Petrolatums

WESTERN PENNA. (Bbls., carloads; tank cars, 0.5c per lb. less.)

Snow White	6.5-7.125	6.5-7.125
Lily White	5.75-6.375	5.75-6.375
Cream White	5-5.875	5-5.875
Light Amber	3.375-4	3.375-4
Amber	3.5-3.75	3.5-3.75
Red	3.5-3.625(2)	3.5-3.625 (2)

Tank Wagon Prices

Commercial or consumer tank car, tank wagon, dealer, and service station prices for gasoline **do not include taxes**; *they do, however, include inspection fees as shown in general footnote. Gasoline taxes, shown in separate column, include 1.5c federal, and state taxes; also city and county taxes as indicated in footnotes. Kerosine tank wagon prices also do not include taxes; kerosine taxes where levied are indicated in footnotes. Dealer discounts are shown in footnotes. These prices in effect June 3, 1946 as posted by principal marketing companies at their headquarters offices, but subject to later correction.*

ATLANTIC REFINING

	Atlantic White Flash (*Regular Grade*) Commercial T.W.	Dealer T.W.	Gasoline Taxes	Kerosine T.W.
Philadelphia, Pa	8.7	9.2	5.5	11.25
Pittsburgh	9.5	10	5.5	11.6
Allentown	9	9.5	5.5	11.6
Erie	9.5	10	5.5	11.6
Scranton	9.5	10	5.5	11.6
Altoona	9.5	10	5.5	11.6
Emporium	9.5	10	5.5	11.6
Indiana	9.5	10	5.5	11.6
Uniontown	9.5	10	5.5	11.6
Harrisburg	9	9.5	5.5	11.6
Williamsport	9.5	10	5.5	11.6
Dover, Del	...	9.7	5.5	11.6
Wilmington, Del	...	9.2	5.5	11.1
Boston, Mass	...	9.7	4.5	....
Springfield, Mass	...	10.6	4.5	....
Worcester, Mass	...	10.2	4.5	....
Fall River, Mass	...	9.8	4.5	....
Hartford, Conn	...	10.3	4.5	....
New Haven, Conn	...	9.8	4.5	....
Providence, R. I	...	9.8	4.5	....
Atlantic City, N. J	...	9.2	4.5	9
Camden, N. J	...	9.2	4.5	9
Trenton, N. J	...	9.2	4.5	9
Annapolis, Md	...	9.55	5.5	9.8
Baltimore, Md	...	8.95	5.5	8.8
Hagerstown, Md	...	10.05	5.5	9.3
Richmond, Va	...	9.5	6.5	11.3
Wilmington, N. C	...	9.8	7.5	10.9
Brunswick, Ga	...	9.5	7.5	*10.1
Jacksonville, Fla	...	9.5	8.5	11.1

	Mineral Spirits T.W.†	V.M.&P. T.W.†
Philadelphia, Pa	11	12.5
Lancaster, Pa	12	13.5
Pittsburgh, Pa	12.5	13.5

FUEL OILS—T.W.

	1	2	3	5	6
Phila., Pa	9.1	8	8	5.65	4.94
Allentown, Pa	9.6	8.3	8.3	....	....
Wilmington, Del.	9.1	8	8	....	....
Springfield, Mass.	...	8.4	8.4	....	....
Worcester, Mass.	...	8.4	8.4	....	....
Hartford, Conn.	...	8.2	8.2	....	....

*Does not include 1c Georgia kerosine tax.

†Mineral Spirits prices also apply to Stoddard Solvent; V.M.&P. prices also apply to Light Cleaners Naphtha.

Discounts:

Gasoline—to undivided dealers, 0.5c off dealer t.w. except Georgia & Florida dealer t.w. and undivided dealer t.w. prices are same.

Kerosine—Thru Penna. & Delaware, 2c off t.w. price on t.w. deliveries of 25 gals. or more at one time.

CONT'L OIL

	Conoco N-tane (regular) †Tank Wagon	Demand (3rd Grade) Wagon	Gasoline Taxes	Kerosine T.W.
Denver, Col	10	9	5.5	10.5
Grand Junc., Col.	12.5	11.5	5.5	13
Pueblo, Col	9.5	8.5	5.5	10
Casper, Wyo	11.5	10.5	5.5	12.5
Cheyenne, Wyo	10	9	5.5	9.5
Billings, Mont	12	11	6.5	13
Butte, Mont	11.5	10.5	6.5	14
Great Falls, Mont.	12	11	6.5	13
Helena, Mont	12	11	6.5	13.5
Salt Lake City, Utah	13.5	12.5	5.5	15
Twin Falls, Ida.	14.5	13.5	7.5	17.5
Albuquerque, N. M.	10.5	9.5	*7	10
Roswell, N. M.	10	9	*7	7.5
Santa Fe, N. M.	10.5	9.5	*7.5	10.5
Ft. Smith, Ark.	9	6.25	8	8.5
Texarkana, Ark.	8.7	7.2	*5.5	7.5
Muskogee, Okla.	7.75	6.75	9	8.5
Oklahoma City, Okla.	8	7	9	8.5
Tulsa, Okla.	8	7	9	8.5

*Taxes: In gasoline tax column are included these city taxes—Albuquerque, & Roswell, 0.5c, Santa Fe, 1c. Texas 4c state tax applies within city limits of Texarkana, Ark.

†To consumers & dealers.

HUMBLE OIL

	Humble (*Regular*) *Tank Wagon	Retail	Thriftane (*3rd Grade*) *Tank Wagon	Retail	Gasoline Taxes
Dallas, Tex.	*7.5	10.5	*6.5	8.5	5.5
Ft. Worth, Tex.	*7.5	10.5	*6.5	8.5	5.5
Houston, Tex.	8.5	12.5	7.5	10.5	5.5
San Ant., Tex.	8.5	12.5	7.5	10.5	5.5

*Consumer t.w. prices are 1c per gal. higher than dealer t.w. prices shown above.

	Kerosine *Tank Wagon	Retail
Dallas, Tex	7.5	10.5
Ft. Worth, Tex	7.5	11.5
Houston, Tex	8.5	11.5
San Antonio, Tex	7.5	10.5

*To all classes of dealers & consumers.

Canada

PRICES OF IMPERIAL OIL, LTD.
Per Imperial Gallon, which is 1.2 U. S. Gallons

IMPERIAL OIL

	Esso Gasoline (*Regular Grade*) †Gasoline T.W.	*Gasoline Taxes	Kerosine T.W.
Hamilton, Ont.	16.5	11	18
Toronto, Ont.	16.5	11	18
Brandon, Man.	21.5	10	23.5
Winnipeg, Man.	20.0	10	22
Regina, Sask.	19.5	11	21.5
Saskatoon, Sask.	22.3	11	24.3
Edmonton, Alta.	20.4	10	22.4
Calgary, Alta.	17.5	10	19.5
Vancouver, B. C.	15	10	24
Montreal, Que.	16.5	11	17.5
St. John, N. B.	16	15	19
Halifax, N. S.	16	13	19

*Includes 3c Federal, and Provincial taxes.

†To divided & undivided dealers.

SOCONY VACUUM

	Socony Mobilgas (*Regular Grade*) Com. Cons. T.W.	Undiv. Dlr. T.W.	Gasoline Taxes
New York City			
Manhattan & Bronx	8.9	9.4	*5.5
Kings & Queens	8.9	9.4	*5.5
Richmond	8.5	9.	*5.5
Albany, N. Y.	8.7	9.2	5.5
Binghamton, N. Y.	9.8	10.3	5.5
Buffalo	9.	9.5	5.5
Jamestown, N. Y.	9.2	9.7	5.5
Mt. Vernon, N. Y.	8.9	9.4	5.5
Plattsburg, N. Y.	9.8	10.3	5.5
Rochester, N. Y.	9.6	10.1	5.5
Syracuse, N. Y.	9.3	9.8	5.5
Bridgeport, Conn.	8.8	9.3	4.5
Danbury, Conn.	9.3	9.8	4.5
Hartford, Conn.	9.3	9.8	4.5
New Haven, Conn.	8.8	9.3	4.5
Bangor, Me.	9.5	10.	5.5
Portland, Me.	9.1	9.6	5.5
Boston, Mass.	8.7	9.2	4.5
Concord, N. H.	10.2	10.7	5.5
Lancaster, N. H.	10.8	11.3	5.5
Manchester, N. H.	10.1	10.6	5.5
Providence, R. I.	8.8	9.3	4.5
Burlington, Vt.	9.7	10.2	5.5
Rutland, Vt.	9.8	10.3	5.5

	Mineral Spirits T.W.	V.M.&P. T.W.
Buffalo, N. Y.	10.5	11.7
New York City	11	12
Rochester, N. Y.	11.5	13
Syracuse, N. Y.	12.2	†16.4
Boston, Mass.	12	13
Bridgeport, Conn.	†16.3	†17.3
Hartford, Conn.	†16.3	†17.3
Providence, R. I.	13	14

	Kerosine Yard	T.W.	Mobilfuel Diesel T.C.	T.W.	Mobilheat Fuel Yard	T.W.
New York City:						
Manhat'n & Bronx	6.5	9.3	...	8.3	6.1	8.
Kings & Queens	6.5	9.3	...	8.3	6.1	8.
Richmond	6.5	9.3	...	...	6.1	8.
Albany	6.5	8.8	5.8	8.3	6.	8.
Binghamton	7.9	10.2	...	9.7	7.4	9.2
Buffalo	7.6	9.9	7.	9.3	7.2	9.
Jamestown	7.7	10.	...	9.6	7.3	9.
Mt. Vernon	6.6	9.3	...	8.4	6.2	8.
Plattsburg	7.1	9.4	...	8.9	6.6	8.4
Rochester	7.7	10.	6.9	9.2	6.9	8.7
Syracuse	7.5	9.8	6.8	9.1	6.8	8.6
Conn.:						
Bridgeport	6.8	9.3	...	8.5	6.3	8.
Danbury	7.2	9.8	...	...	6.8	7.5
Hartford	7.	9.5	...	8.5	6.4	8.2
New Haven	6.3	9.3	6.	8.3	5.9	8.
Maine:						
Bangor	6.9	9.3	6.4	8.7	6.4	8.1
Portland	6.5	9.2	5.8	8.3	6.	8.0

Tank Wagon Prices—Continued

	Kero-sine		Mobil-fuel Diesel		Mobil-heat Fuel	
	Yard	T.W.	T.C.	T.W.	Yard	T.W.
Mass.:						
Boston	6.8	9.6	5.8	8.3	6.2	8.1
N. H.:						
Concord	7.4	9.7	...	9.6	7.3	9.1
Lancaster	8.5	10.8	...	10.5	8.2	10.0
Manchester	7.5	10.1	..	9.3	7.0	8.8
R. I.:						
Providence	6.8	9.3	5.8	8.3	6.2	8.1
Vermont:						
Burlington	7.1	9.4	6.5	8.8	6.5	8.2
Rutland	7.3	9.6	...	9.0	6.7	8.5

*Does not include 1% city sales tax applicable to price of gasoline (ex tax).
†In steel barrels.
Discounts: Diesel—On t.w. deliveries, 0.5c for at least 400 gals.; 1c for full tank truck.

S. O. CAL.

	—CHEVRON— (Regular) T.T.	Retail	Av. 80 T.T.	Gaso-line Taxes	Kero-sine T.T.
San Francisco, Cal.	10	14	13.5	4.5	12.25
Los Angeles, Cal.	9.5	13.5	13	4.5	10.75
Fresno, Cal.	11	15	14.5	4.5	13.25
Phoenix, Ariz.	12	16	15.5	6.5	13.25
Reno, Nev.	12	16	15.5	5.5	14.25
Portland, Ore.	10.5	14.5	14	6.5	14.25
Seattle, Wash.	10.5	14.5	†14	6.5	14.25
Spokane, Wash.	12.5	16.5	†17	6.5	17.25
Tacoma, Wash.	10.5	14.5	†14	6.5	14.25
Boise, Idaho	13.5	17.5	17	7.5	17

Resale and Commercial Gasoline—Tank car deliveries of Chevron Aviation 80, unleaded, and Chevron Gasoline .25c per gallon below posted net tank truck price. Pearl Oil (The Standard Kerosine)—Tank car deliveries 3c below posted tank truck price.

Note—See page 52 for effective dates of Chevron Avgas prices.

S. O. IND.

	Red Crowns (Reg Grade) Blue Crowns (3rd Grade) Red Cr'n. Cons. T.W.	Red Cr'n. Dlr. T.W.	Blue Cr'n. Dlr. T.W.	Gaso-line *Taxes	Kero-sine T.W.
Chicago, Ill.	11.6	9.6	9.1	4.5	11.1
Decatur, Ill.	11.3	9.6	8.7	4.5	10.8
Joliet, Ill.	11.6	10.1	9.2	4.5	11.1
Peoria, Ill.	11.4	9.9	9.4	4.5	10.9
Indianapolis, Ind.	11.3	9.8	9.3	5.5	10.6
Evansville, Ind.	11.1	9.6	8.6	5.5	10.4
South Bend, Ind.	11.7	10.2	9.7	5.5	11.0
Detroit, Mich.	11.1	9.6	...	4.5	10.5
Grand Rapids, Mich.	11.1	9.6	...	4.5	10.4
Saginaw, Mich.	11.1	9.6	...	4.5	10.4
Green Bay, Wisc.	11.9	10.4	9.9	5.5	11.4
Milwaukee, Wis.	11.8	10.3	9.8	5.5	11.3
La Crosse, Wis.	11.6	10.1	9.6	5.5	11.1
Minneapolis - St. Paul	11.5	10.1	9.6	5.5	11.1
Duluth, Minn.	11.9	10.4	...	5.5	11.4
Mankato, Minn.	11.6	10.1	9.6	5.5	11.1
Des Moines, Ia.	11.1	9.6	9.1	5.5	10.6
Mason City, Ia.	11.4	9.9	9.4	5.5	10.9
St. Louis, Mo.	11.0	9.5	9.1	4.5	10.6
Kansas City, Mo.	10.7	9.2	8.6	4.5	10.2
St. Joseph, Mo.	10.7	9.2	...	4.5	10.4
Fargo, N. D.	12.6	11.1	10.6	5.5	12.1
Huron, S. D.	12.0	10.5	10.0	5.5	11.5
Wichita, Kans.	9.5	8.6	7.2	5.5	9.5
Omaha, Neb.	11.1	9.6	9.1	6.5	10.6

Stanavo Ethyl Aviation Number 73

	Cons. T.W.	*Taxes
Detroit, Mich.	15.7	4.5
Fargo, N. D.	15.1	5.5
Huron, S. D.	14.5	5.5
Indianapolis, Ind.	14.2	5.5
Kansas City, Mo.	13.2	4.5

	Oleum Spirits	V.M. & P. Naphtha	Stani-sol	*Taxes
(Prices are base prices before discounts)				
Chicago	13.5	13.8	12.8	4.5
Detroit	15.8	15	16.3	4.5
K. C., Mo.	13.3	14.3	13.8	1.5
St. Louis, Mo.	13.7	14.7	13.2	1.5
Milwaukee	14.4	15.4	14.9	5.5
Minneap'ls	14.2	15.2	13.5	5.5

Fuel Oils T.W. Chicago

	Standard Heater Oil	Stanolex Furnace Oil
1-99 gals.	9.8	9.3
100-149 gals.	8.8	8.3
150 gals. & over	8.3	...
150-399 gals.	...	8.3
400 gals. & over	...	7.8

	Stanolex Fuel A	Stanolex Fuel C
1-749 gals.	7.0	6.2
925 gals. & over	6.25	5.45

Stanolex Furnace Oil

Other Points	1-99 gals.	100 gals. & over
Indianapolis	9.5	8.5
Detroit	9.2	8.2
Milwaukee	9.5	8.5
Minneapolis	9.6	8.6
St. Louis	8.9	7.9
Kansas City	8.6	7.6

*Taxes: In gasoline tax column are included these city taxes—Kansas City, St. Joseph and St. Louis, 1c. Iowa kerosine prices are ex 4c state tax. In naphtha tax column are included 1.5c federal tax and state taxes. State sales, occupation, consumer and use taxes to be added where applicable.

S. O. KY.

Crown Gasoline (*Regular*)

	†Crown Net Dealer	Gaso-line Taxes	Kero-sine T.W.
Covington, Ky.	9.5	6.5	9.8
Lexington, Ky.	10.25	6.5	9.8
Louisville, Ky.	9.75	6.5	9.3
Paducah, Ky.	9.75	6.5	9.3
Jackson, Miss.	9.5	7.5	*9.5
Vicksburg, Miss.	9.25	7.5	*9.0
Birmingham, Ala.	9.75	*8.5	9.5
Mobile, Ala.	9	*9.5	9.0
Montgomery, Ala.	10.00	*9.5	*10.5
Atlanta, Ga.	10.25	7.5	*11.1
Augusta, Ga.	10.25	7.5	*10.6
Macon, Ga.	10.25	7.5	*11.1
Savannah, Ga.	9.5	7.5	*10.1
Jacksonville, Fla.	9.5	8.5	9.1
Miami, Fla.	9.5	8.5	9.1
Pensacola, Fla.	9	*9.5	8.5
Tampa, Fla.	9.5	8.5	9.1

*Taxes: In tax column are included these city and county gasoline taxes: Mobile, 2c city; Birmingham, 1c city, Montgomery, 1c city and 1c county; Pensacola, 1c city. Georgia and Montgomery, Ala. have 1c kerosine tax, Mississippi 0.5c, included in above prices.
†Consumer t.w. prices are same as net dealer prices.

S. O. N. J.

Esso (*Regular Grade*)

	Consumer Tank Wagon	Dealer T.W.	Gaso-line Taxes	Kero-sine T.W.
Atlantic City, N. J.	8.70	9.20	4.5	9.0
Newark	8.70	9.20	4.5	9.0
Annapolis, Md.	9.05	9.55	5.5	...
Baltimore	8.45	8.95	5.5	8.8
Cumberland	9.85	10.35	5.5	10.3
Washington, D. C.	8.70	9.20	4.5	9.3
Danville, Va.	9.60	10.10	6.5	9.7
Petersburg	9.25	9.75	6.5	9.2
Norfolk	8.70	9.20	6.5	9.0
Richmond	9.0	9.50	6.5	9.3
Roanoke	10.20	10.70	6.5	10.0
Charleston, W. Va.	10.30	10.80	6.5	11.1
Parkersburg	10.30	10.80	6.5	10.8
Wheeling	10.05	10.55	6.5	11.4
Charlotte, N. C.	9.80	10.30	7.5	9.6
Hickory	10.20	10.70	7.5	10.6
Mt. Airy	10.40	10.90	7.5	9.8
Raleigh	10.10	10.60	7.5	10.6
Salisbury	9.90	10.40	7.5	11.0
Charleston, S. C.	9.20	9.70	7.5	...
Columbia	10.10	10.60	7.5	...
Spartanburg	9.60	10.10	7.5	...
New Orleans, La.	8.45	8.95	8.5	*7.5
Baton Rouge	8.45	8.95	8.5	*8.0
Alexandria	8.45	8.95	8.5	*8.0
Lake Charles	8.70	9.20	8.5	*9.5
Shreveport	8.20	8.70	8.5	*6.5
New Iveria, La.	8.70	9.20	8.5	*7.5
Knoxville, Tenn.	9.95	10.45	8.5	11.0
Memphis	8.90	9.40	8.5	9.0
Chattanooga	°8.40	8.90	8.5	9.5
Nashville	10.20	10.70	8.5	8.5
Bristol	9.45	9.95	8.5	10.5
Little Rock, Ark.	9.20	9.70	8.0	10.5

°Reduction in consumer t.w. price was effective May 24, instead of May 17 as stated in NPN of May 29.

	Mineral Spirits T.W.	V.M.&P. T.W.
Newark, N. J.	13	14.5
Baltimore, Md.	15.5	....
Washington, D. C.	15.5	....

Fuel Oils—T.W.	No. 1	No. 2
Atlantic City, N. J.	9.0	8.0
Newark	9.0	8.0
Baltimore, Md.	8.8	8.0
Washington, D. C.	9.3	8.4
Norfolk, Va.	9.0	7.8
Petersburg	9.3	8.0
Richmond	9.3	8.0
Charlotte, N. C.	9.6	9.4
Hickory	...	9.0
Raleigh	10.6	9.1
Charleston, S. C.	...	8.0
Columbia	...	9.0
Spartanburg	...	9.8

*Does not include 1c Louisiana kerosine tax
Discounts:

Esso gasoline—to undivided dealers, 0.5c off dealer t.w.

Kerosine—In South Carolina 1c per gal. off posted t.w. price for 25 gals. or more. In Arkansas 2c per gal. off posted t.w. price.

Naphtha—To buyers taking following quantities at one time: Newark, 2c per gal. on 200 gals. or more, less than 200 gals. 0.5c higher price; Baltimore, 2c off on 25 to 100 gals. and 3c on over 100 gals.; Washington, 2c off to contract buyers.

S. O. OHIO

Sohio X-70 Gasoline (*Regular Grade*)

	Consumer T.W.	Re-sellers	°S.S.	Gaso-line Taxes	Kero-sine T.W.
Ohio, Statewide	†12	10	13.5	5.5	9.8
Akron	12	9.5	12.5	5.5	9.8
Canton	12	9.5	12.5	5.5	9.8
Cincinnati	12	9.5	12.5	5.5	9.8
Cleveland	12	9.5	12.5	5.5	9.8
Columbus	12	9.5	12.5	5.5	9.8
Dayton	12	9.5	12.5	5.5	9.8
Lima	12	9.5	12.5	5.5	9.8
Mansfield	12	9.5	12.5	5.5	9.8
Marion	12	9.0	12.0	5.5	9.8
Portsmouth	12	9.5	12.5	5.5	9.8
Toledo	12	9.5	12.5	5.5	9.8
Youngstown	12	9.5	12.5	5.5	9.8
Zanesville	12	9.5	12.5	5.5	9.8

Aviation Gasoline—Statewide

	Consumer Gasoline T.W.	Taxes
Sohio Aviation Gasoline Clear Spec. AN-F-22, Amend. 1	14.5	5.5
Esso Ethyl Avia. Grade 73	15.5	5.5
Esso (Clear) Avia. Grade 80	16.5	5.5
Esso Aviation Grade 91/98	17.5	5.5
Esso Aviation Grade 100/130	20.5	5.5

Naphtha—T.W.

	Statewide
S. R. Solvent	13.5
D. C. Naphtha	14
V.M.&P. Naphtha	14
Varnolene	14
Sohio Solvent	14

Fuel Oils—T.W.	No. 1	No. 2	No. 3	No. 4
Ohio, Statewide	8.8	8.8	8.3	*8.05

**Renown (third-grade) prices are same as X-70 unless otherwise noted.

°Prices at company-operated stations.

††Statewide prices are subject to exceptions other than those shown.

Discounts:

Esso aviation—on contract to hangar operators and resellers, 2c off consumer t.w.

*For Cleveland area only. Full compartment hose dumps.

Fuel oils—Statewide prices are for t.w. & drum deliveries of 50 gals. or more; prices for deliveries of less than 50 gals. are 0.5c higher.

Naphthas—to contract consumers off t.w. prices—Statewide: 300 to 999 gals., 0.5c; 1000 to 2499 gals., 0.75c; 2500 to 4999 gals., 1c; 5000 or more gals., 1.5c. Lucas County: Less than 50 gals., tank wagon price, 50 to 249 gals., 0.5c; 250 to 499 gals., 1c; 500 gals. or over, 1.5c.

TEXAS CO.

	Gasoline—Dealer T.W. Fire-Chief (*Regular*)	Indian (*3rd Grade*)	Gaso-line Taxes
Dallas, Tex.	7.5	6.5	5.5
Ft. Worth, Tex.	7.5	6.5	5.5
Wichita Falls, Tex.	8.5	7.5	5.5
Amarillo, Tex.	8.5	7.5	5.5
Tyler, Tex.	8.5	7.5	5.5
El Paso, Tex.	11	10.5	5.5
San Angelo, Tex.	8.5	7.5	5.5
Waco, Tex.	8.5*	7*	5.5
Austin, Tex.	8.5	7.5	5.5
Houston, Tex.	8.5	7.5	5.5
San Antonio, Tex.	8.5	7.5	5.5
Port Arthur, Tex.	8.5	7.5	5.5

*Less 1c temporary allowance to all dealers.

Notice

Tank Wagon prices include inspection fees on both gasoline and kerosine unless otherwise specified per gallon as follows:

Ala. 1/40c on gasoline; Ark. 1/20c; Fl. 1/8c; Ill. 3/100c; Ind. 2/25c; Kans. 1/50c; La. 1/32c; Minn. 7/200c; Neb. 2/100c; Nev. 1/20c; N. C. 1/4c; N. Da. 1/20c; Okla. 2/25c; S. Car. 1/8c; S. Da. 1/40c; Tenn. 2/5c; and Wisc. 3/100c.

Kerosine inspection fees only: Ala. 1/2c; Fla. 1/8c; Iowa 3/50c; Mich. 1/5cper gal.

Atlantic Coast

Seaboard Export Coastwise Prices

(Prices are of refiners, FOB their refineries and tanker terminals, and of tanker terminal operators FOB their terminals)—Prices in Effect June 3

	MOTOR GASOLINE (ASTM Octane)		KEROSINE & FUEL OILS				
District	74-77 Oct.	78-80 Oct. (Ethyl)	KEROSINE &/OR NO. 1 FUEL	NO. 2 FUEL	NO. 3 FUEL	No. 5	No. 6
N. Y. Harb.	6.25-8	7.25-8.95	6.1	5.7	5.7 (1)	$1.90 (a)	$1.72
N. Y. Harb., barges	6.15-7.6	7.15-7.9	6	5.6	5.6 (1)	....	....
Albany	8.1-8.15	9.15-9.6(2)	6.3	5.8	5.8 (1)	....	$1.92 (1)
Philadelphia	6.25-7.7	7.25-8.95	6.2	5.7	5.7	$1.93	$1.72
Philadelphia, barges	6.15-6.9	7.15-7.9	....	....	....	....	....
Baltimore	6.25-7.45	7.25-8.7	6.2	5.7	5.7 (1)	$1.80(1)	$1.72
Baltimore, barges	6.15-6.9	7.15-7.9	....	....	....	....	....
Norfolk	6.75-7.1	7.75(1)	6.1	5.7	....	$1.76(1)	$1.68
Wilmington, N. C.	6.65-7.35	7.65(2)	6.05	5.7	....	....	....
Charleston	6.65-7.05	7.65(2)	6.2	5.7	....	$1.71(1)	$1.63 (2)
Savannah	7-7.37	8(2)	6.05	5.25	5.25 (1)	....	$1.63 (1)
Jacksonville	7-7.375	8-8.375	6.05	5.25	....	....	$1.58-1.63
Miami	7-7.375	8-8.375	6.05	5.25 (2)	....	....	....
Tampa	7-7.375	8-8.375	6.05	5.25	....	....	$1.49-1.53
Pensacola	6.625-7(2)	....	5.3 (1)	5.25 (1)	....	....	....
Mobile	6.5-6.87(2)	....	5.25 (2)	....	....	....	....
New Orleans	6	6.75(2)	4.625	4.25 (2)	....	$1.26(1)	$1.18
Portland	8.1-8.3	9.55-9.8(2)	6.3	5.8	5.8 (1)	$2.245 (1)	$1.765
Boston	7.1-8.2	8.1-9.7	6.2	5.8	5.8 (1)	$1.945	$1.765
Providence	8-8.2	9.45-9.7(2)	6.2	5.8	5.8 (1)	$1.865(2)	$1.735
New Haven	....	....	....	....	....	....	$1.735(1)

(a) Price is for straight-run low pour test No. 5; three refineries quote $1.80 for high pour test No. 5.

	Bunker C Fuel Ships' bunkers (Ex Lighterage)	Diesel Oil Ships' bunkers (Ex Lighterage)	Diesel Oil Shore Plants	Gas House Gas Oil 28-34 Gravity
N. Y. Harbor	$1.72	$2.36	5.7 (1)	5.8 (2)
Albany	$1.92(1)	$2.52 (1)	5.8 (1)	6 (1)
Philadelphia	$1.72	$2.36	....	....
Baltimore	$1.72	$2.36 (2)	5.7 (1)	....
Norfolk	$1.68	$2.36 (2)	5.7 (1)	....
Charleston	$1.63(2)	$2.36 (2)	5.7 (1)	....
Savannah	$1.63 (1)	....	....	....
Jacksonville	$1.58-1.63	$2.20 (1)	....	....
Tampa	$1.49-1.53	....	....	....
New Orleans	$1.18	$1.86 (1)	....	....
Portland	$1.765	....	5.8 (1)	5.9 (1)
Boston	$1.765	$2.40 (1)	5.8 (2)	5.9 (1)
Providence	$1.735	$2.402 (2)	5.8 (1)	5.9 (1)
New Haven	....	....	....	....

Gulf Coast

Prices in Effect June 3

MOTOR GASOLINE	New Orleans & Lower Mississippi to Baton Rouge Tank Cars	New Orleans & Lower Mississippi to Baton Rouge Barges	Texas Gulf Coast South of New Orleans Tank Cars	Texas Gulf Coast South of New Orleans Barges	CARGOES Domestic & Export From all Gulf Ports
78-80 Oct. Ethyl	6.75	6.5	....	6.5-6.75	6.375-6.75
74-77 Oct.	6	5.75	5.75-6(a)	5.75	5.75
70 Oct.	....	....	....	....	5.5-5.625
Unleaded (ASTM Oct.)					
70 Oct.	....	....	....	....	5.625
68 Oct.	....	....	....	....	5.5
65 Oct.	....	5.25	....	....	5.25
60 Oct.	....	....	....	....	5
KEROSINE & LIGHT FUELS					
41-43 w.w. kero	4.625	4.625	4.625	4.625	4.625
42-44 w.w. kero	....	....	4.625	4.625	4.625
No. 2 fuel oil	4.25	4.25	4.25	4.25	4.25
DIESEL & GAS OILS (In diesel index No.)					
No. 5 fuel oil	$1.26	$1.26	$1.26	$1.26	$1.26
43-47 di.	....	....	....	....	4.5
48-52 di.	4.5	4.5	4.5	4.5	4.5
53-57 di.	4.625	4.625	4.625	4.625	4.625
58 and above	4.75	4.75	4.75	4.75	4.75

(a) One refiner quotes 5.75c for shipment to Dist. 1, 6c for shipment to other districts; one other refiner quotes 5.75c for unrestricted shipment.

NOTE: Above products in Truck Transports of 2,400 gal. and over 0.125c above Tank Car Prices

HEAVY FUELS & BUNKER OIL (all Gulf Ports) Heavy Diesels	In Cargoes	In Ship's Bunkers (Ex Lighterage)
Below 28 API Grav.	....	$1.35 -$1.56
28 & above API Grav.	....	$1.86
Bunker C Oil	$1.18	$1.18

TANKER RATES

Approximate rates, cents per bbl.; Gulf-N. Atlantic, not east of New York

Heavy crude & fuel, 10-19.9 grav.	43.8
Light crude, 30 grav. or lighter	39
Gasoline	32.9
Kerosine	36
No. 2 fuel	38

Mid-Continent Lubes

(At Gulf; in packages, FAS. New Orleans; in bulk, FOB terminals).

Prices in Effect June 3

Bright Stock *D color, Vis at 210°*	Steel Drums	Bulk
150 vis., 0-10 p.p.	32.65 (1)	24.8 (1)

Pacific Coast

(In Ships' Bunkers, or Deep Tank Lots)

	Prices in Effect June 3 Diesel Fuel (P.S. 200)	Bunker C Fuel (P.S. 400)
San Pedro, Calif.	$1.765	$1.25
San Francisco, Calif.	1.815	1.30
Portland, Ore.	2.015	1.45
Seattle, Wash.	2.015	1.45

Wax

(Melting points are AMP, 3° higher than EMP. Prices are FOB refinery and do not include bag, freight or export differentials).

Prices in Effect June 3

Crude Scale	New Orleans Export	N. Y. Domestic	N. Y. Export
124-6 Yellow	4.25 (1)	....	4.25(1)
122-4 White	....	4.25 (2)	4.25(2)
124-6 White	4.25 (1)	4.25	4.25
Fully Refined:			
123-5	5.2 (1)	5.2 (2)	5.2 (1)
125-7	5.2 (1)	5.2 (2)	5.2 (2)
128-30	5.6 (1)	5.6	5.6 (1)
130-32	5.85 (1)	5.85 (2)	5.85 (1)
133-5	6.15 (1)	6.15	6.15 (2)
135-7	6.4 (1)	6.4 (1)	6.4 (1)

Naphtha

Effective June 3

	V.M.&P. Naphtha	Mineral Spirits
New York Harbor	11 (2)	10
Philadelphia	11 (2)	10
Baltimore	10.5 (2)	9.5
Boston	11.5 (2)	10.5
Providence	11.5 (1)	10.5 (2)

Export Prices

Prices in Effect June 3

	Mexican Gulf Ports U. S. Dollars per Bbl. Bunker C (Ships' Bunkers)	Diesel (Ships' Bunkers)
Tampico	$1.18	$1.86
Veracruz	1.18	....
Coatzacoalcos	1.18	1.86
Pacific Coast		
Guaymas	$1.65	$3.22
Mazatlan	1.65*	3.22
Acapulco	1.65	2.89
Manzanillo	1.65	2.89
Salina Cruz	1.65	2.89

Note: All bunkers sales subject to Mexican stamp tax of 1.65% ad valorem.

*Port accessible only for small vessels drawing 14 to 15 feet.

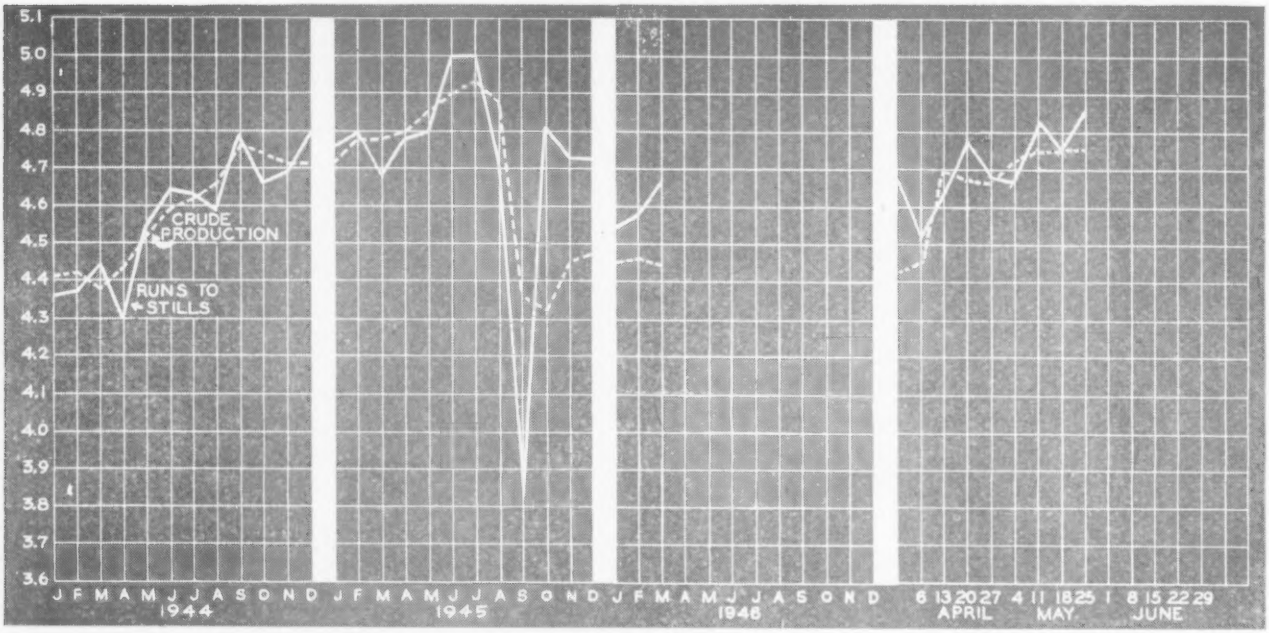
NPN Gasoline Index

	Dealer T.W.	Tank Car
	Cents Per Gal.	
June 3	9.80	6.31
Month ago	9.80	6.24
Year ago	10.27	6.72

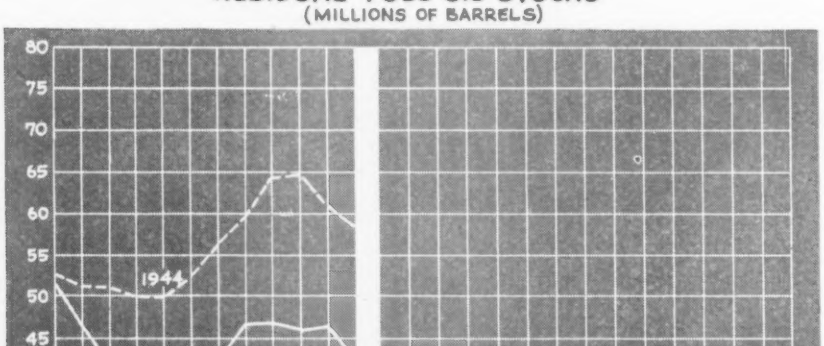
Dealer index is an average of "undivided" dealer prices, ex-tax, in 50 cities.

Tank car index is weighted average of following wholesale markets for regular-grade gasoline, FOB refineries or terminals: Okla., Mid-Western, W. Penna., Calif., N. Y. Harbor, Philadelphia, Jacksonville, Boston and Gulf Coast.

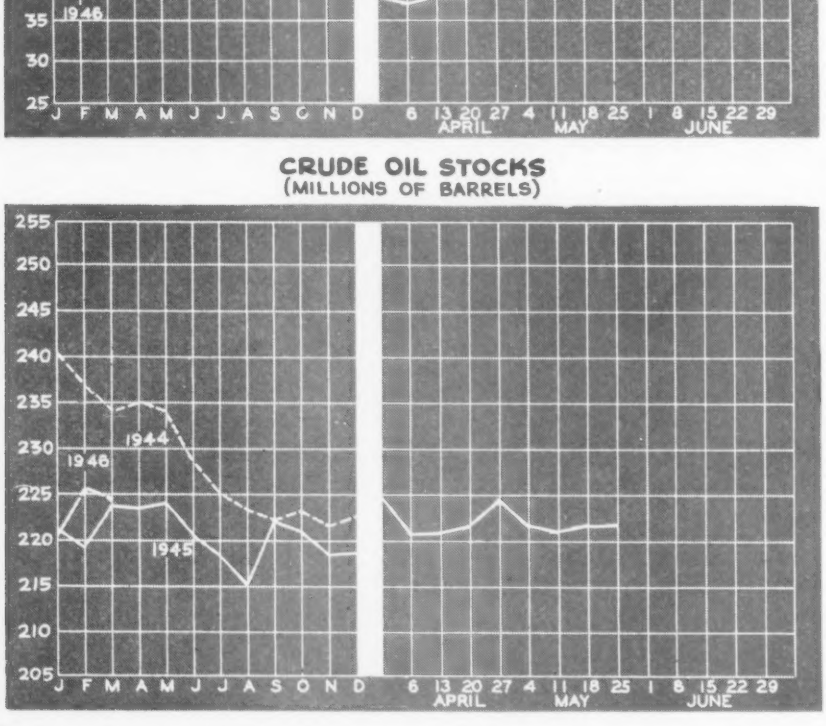
CRUDE PRODUCTION AND RUNS TO STILLS
(MILLIONS OF BARRELS)



RESIDUAL FUEL OIL STOCKS
(MILLIONS OF BARRELS)



CRUDE OIL STOCKS
(MILLIONS OF BARRELS)



Daily Ave. Pennsylvania Crude Runs

(Compiled by National Petroleum Assn. from reports of all companies refining Pennsylvania crude. Figures in bbls.)

Week Ended May 25, 1946	Week Ended May 18, 1946	Week Ended May 26, 1945
65,372	62,285	57,516

Crude Oil Stocks

(Thousands of Bbls.)

Grade or Origin	May 18	May 25	Change from May 18
Penna. Grade	2,369	2,404	+ 35
Other Appalachian	1,746	1,659	— 87
Lima-Michigan	1,126	1,107	— 19
Illinois-Indiana	18,831	18,613	—218
Arkansas	2,411	2,429	+ 18
Kansas	8,705	8,680	— 25
Louisiana	10,896	11,035	+139
North	3,002	2,983	— 19
Gulf Coast	7,894	8,052	+158
Mississippi	2,289	2,195	— 94
New Mexico	6,266	5,876	—390
Oklahoma	33,753	33,764	+ 11
Texas	101,616	102,576	+960
East Texas	16,985	16,314	—671
West Texas	33,772	34,196	+424
Gulf Texas	26,490	27,215	+725
Other Texas	24,369	24,851	+482
Panhandle	4,599	4,389	—210
North	6,256	6,321	+ 65
South	5,007	5,523	+516
Other	8,507	8,618	+111
Rocky Mountain	8,182	8,213	+ 31
California	20,321	20,230	— 91
Foreign	3,602	3,433	—169
Total Gasoline-Bearing in U. S.	222,113	222,214	+101
Heavy in California	4,778	4,699	— 79

REFINERY OPERATIONS

(American Petroleum Institute figures in thousands of barrels of 42 gallons each. Figures include reported totals plus estimate of unreported amounts and are therefore on a Bureau of Mines basis.)

Districts	Daily Average Crude Runs to Stills Week Ended		Gasoline Production at Refineries Inc. Natural Blended Week Ended		Kerosine Production Week Ended		Gas Oil & Dist. Fuel Oil Production Week Ended		Residual Fuel Oil Production Week Ended	
	May 25	May 18	May 25	May 18	May 25	May 18	May 25	May 18	May 25	May 18
East Coast	802	802	1,872	1,890	267	244	1,068	1,109	1,681	1,514
Appalachian (Dist. 1)	103	97	306	307	45	49	88	73	107	80
Appalachian (Dist. 2)	55	60	184	188	7	18	46	39	77	83
Ind., Ill., Ky.	788	756	2,684	2,572	244	299	741	662	1,119	1,131
Okla., Kans., Mo.	395	389	1,304	1,314	202	182	374	416	463	451
Inland Texas	234	217	926	903	90	81	98	87	413	397
Texas Gulf Coast	1,151	1,189	3,233	3,573	683	652	1,623	1,703	1,882	1,813
Louisiana Gulf Coast	329	293	914	802	332	307	560	479	326	237
No. La. & Arkansas	60	57	151	154	37	40	69	65	107	98
Rocky Mt. (Dist. 3)	10	10	37	37	6	6	9	9	26	27
Rocky Mt. (Dist. 4)	125	124	382	402	16	14	108	120	295	265
California	801	762	2,329	2,056	112	92	679	833	2,412	2,324
Total U. S.—B. of M. Basis	4,857	4,756	14,322	14,198	2,041	1,984	5,463	5,595	8,908	8,420
U. S.—B. of M. Basis, May 26, 1945	4,996		15,252		1,432		4,816		9,532	

Districts	Total Stocks Kerosine Week Ended		Total Stocks Gas Oil and Distillates Week Ended		Total Stocks Residual Fuel Oil Week Ended		Stocks of Finished and Unfinished Gasoline Week Ended		Per Cent Daily Refining Capacity Reported Week Ended	
	May 25	May 18	May 25	May 18	May 25	May 18	May 25	May 18	May 25	May 18
East Coast	5,028	5,079	10,556	10,092	8,133	7,497	22,901	22,950	99.5	99.5
Appalachian (Dist. 1)	205	231	364	390	192	154	2,568	2,635	76.8	76.8
Appalachian (Dist. 2)	59	62	113	97	184	182	1,027	1,031	81.2	81.2
Ind., Ill., Ky.	1,733	1,737	4,222	4,101	3,321	3,276	20,273	20,831	87.2	87.2
Okla., Kans., Mo.	628	614	1,781	1,691	1,143	1,106	8,152	8,131	78.3	78.3
Inland Texas	314	299	319	310	637	695	3,080	2,982	59.8	59.8
Texas Gulf Coast	2,189	1,893	5,667	5,560	4,882	4,770	14,763	14,820	89.3	89.3
Louisiana Gulf Coast	1,152	1,011	1,652	1,653	1,295	1,206	3,785	4,109	96.8	96.8
N. La. & Arkansas	187	206	388	441	192	193	1,805	1,759	55.9	55.9
Rocky Mt. (Dist. 3)	10	10	37	36	39	41	92	92	17.1	17.1
Rocky Mt. (Dist. 4)	122	122	384	388	746	670	2,207	2,232	72.1	72.1
California	608	584	7,490	7,427	22,604	22,085	15,116	15,478	86.5	86.5
Total U. S.—B. of M. Basis	12,235	11,848	32,975	32,186	43,368	41,875	°95,769	97,050	85.7	85.7
U. S.—B. of M. Basis May 26, 1945	8,528		29,246		38,891		†88,361			

Unfinished gasoline stocks included are: °8,206,000 bbls.; †11,515,000 bbls.

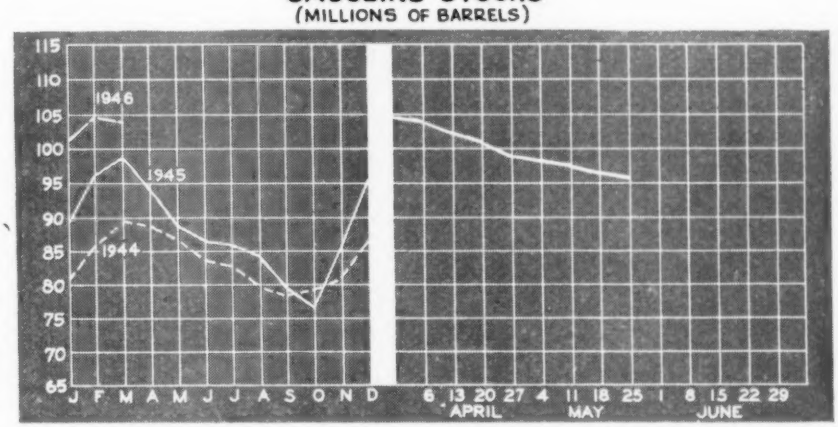
U. S. Crude Oil Production

(American Petroleum Institute figures)

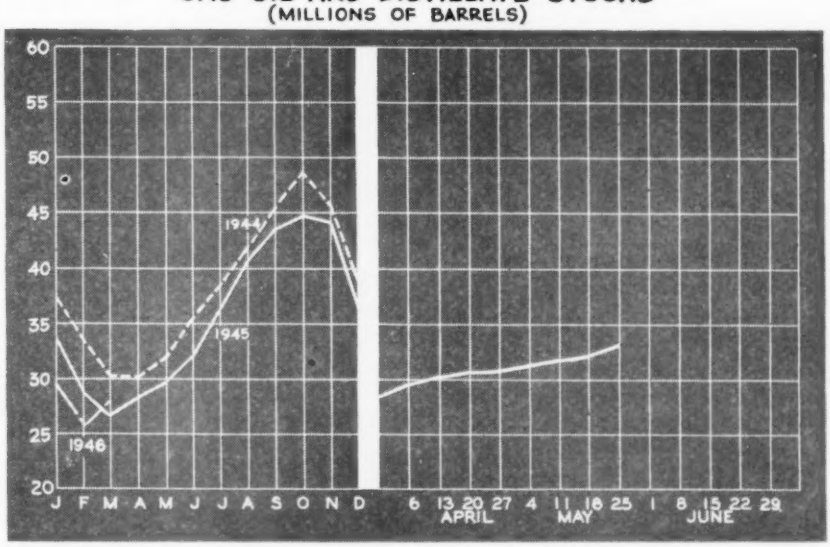
	WEEK ENDED May 25 Barrels	WEEK ENDED May 18 Barrels
	(Daily Average)	
°New York-Penna.	49,200	51,700
Florida	250	250
°West Virginia	7,800	7,900
°Ohio—Southeast	5,500	5,750
Ohio—Other	2,550	2,650
Indiana	19,000	20,400
Illinois	209,050	207,850
Kentucky	30,700	30,150
Michigan	48,050	46,000
Nebraska	°° 750	750
Kansas	°°270,150	261,350
Oklahoma	°°372,650	373,400
Panhandle Texas	83,000	83,000
North Texas	164,800	164,800
West Texas	521,100	521,100
East Central Texas	139,600	139,600
East Texas	388,800	388,800
Southwest Texas	331,500	331,500
Coastal Texas	486,000	486,000
Total Texas	2,114,800	2,114,800
North Louisiana	79,850	78,650
Coastal Louisiana	291,450	291,450
Total Louisiana	371,300	370,100
Arkansas	72,900	72,250
Mississippi	63,100	61,850
Alabama	1,150	1,050
New Mexico—Southeast	95,300	95,300
New Mexico—Other	500	500
Wyoming	115,700	112,950
Montana	19,350	19,400
Colorado	29,100	29,600
California	860,200	865,400
Total U. S.	4,759,100	4,751,350
°Penna. Grade included	62,550	63,350

°°Okla. Kans. Neb. figures are for week ended 7 a.m. May 22.

GASOLINE STOCKS
(MILLIONS OF BARRELS)



GAS OIL AND DISTILLATE STOCKS
(MILLIONS OF BARRELS)



Pacific Coast Demand

(Bureau of Mines figures in thousands of b/d)

	Gasoline		Gas Oil & Diesel		Heavy Fuel Oil		All Products	
	1945	1946	1945	1946	1945	1946	1945	1946
January	304	248	104	139	545	432	1,066	917
February	315	283	100	129	594	439	1,124	947
March	332	300	94	106	519	448	1,068	962
April	406	...	83	...	536	...	1,148	...
May	402	...	75	...	520	...	1,135	...
June	398	...	64	...	490	...	1,085	...
July	396	...	59	...	421	...	1,011	...
August	370	...	78	...	434	...	1,010	...
September	363	...	76	...	400	...	954	...
October	269	...	76	...	443	...	897	...
November	271	...	106	...	418	...	901	...
December	265	...	117	...	479	...	969	...
Jan.-Mar.	317	276	99	124	551	440	1,085	942

Midcontinent Lubricating Oils

(All figures are in bbls. of 42 gals.)

	Bright Stocks	Viscous Neutrals	Paraffin Oils	Steam Refined Stock	Blended Oils
Production	255,866	337,354	66,413	33,254	350,857
Shipments:					
Domestic	255,111	326,723	65,736	31,685	335,904
Export	1,050	1,968		487	8,763
TOTAL	256,161	328,691	65,736	32,172	344,667
Inventory March 31	340,942	215,302	67,508	26,281	186,095
Days Supply	46	21			

Pennsylvania Lubricating Oils

(Compiled by National Petroleum Assn. from reports of companies refining Pennsylvania Grade crude oil. Figures in bbls.)

	Production March, 1946	Inventory March, 1946	Production Feb., 1946	Inventory Feb., 1946
Raw Long Residuum	17,801	5,484	17,997	17,799
600 Steam Refined Stock	266,035	120,611	237,295	110,656
Other Steam Refined Stock	43,305	43,337	39,619	48,006
Finished Dewaxed Long Residuum	47,135	38,661	33,090	26,664
Bright Stock	172,837	200,768	151,419	241,062
Viscous Neutral (below 180 Vis.)	59,887	126,670	53,027	130,596
Viscous Neutral (180 Vis. at 100)	102,759	96,713	99,287	90,029

Production of Natural Gasoline

(Bureau of Mines figures in gallons, 000 omitted)

	Mar. 1946	Feb. 1946
East Coast	...	...
W. New York	1	1
W. Pennsylvania	1,093	1,230
West Virginia	8,532	9,319
Ohio	518	482
Illinois	13,470	11,634
Kentucky	3,846	5,039
Michigan	1,151	1,007
Kansas	6,223	6,648
Oklahoma	35,506	34,533
Texas:	183,148	171,605
Gulf	43,308	41,300
East Texas	27,939	24,526
Panhandle	44,469	43,136
Other	67,432	62,643
Arkansas	6,565	6,471
Louisiana:	43,760	47,960
Gulf	24,935	26,797
Inland	18,825	21,163
New Mexico	8,000	7,324
Colorado	*	*
Montana	450	459
Utah	*	*
Wyoming	*3,332	*3,192
California	75,989	71,530
Total	391,584	378,434
Daily average	12,632	13,516
Total (thousands of bbls.)	9,323	9,011
Daily average	301	322

* Wyoming includes Colorado and Utah drip gasoline.

Dealer and Service Station Gasoline Price In 50 Representative U. S. Cities May 1, 1946

(American Petroleum Institute Figures)

City & State	Dealers' Net Price (Ex. Tax)	Indicated Dealer Margin	Gasoline Tax (Inc. 1½ Cent Federal Tax)	Service Station (Inc. Tax)
Average United States	9.89	4.24	6.07	20.20
Portland, Me.	9.60	3.35	5.05	19.00
Manchester, N. H.	10.40	4.3	5.50	20.20
Burlington, Vt.	10.20	4.0	5.50	19.70
Boston, Mass.	9.20	4.0	4.50	17.70
Providence, R. I.	9.20	4.3	4.50	18.00
Hartford, Conn.	9.60	4.3	4.50	18.40
Buffalo, N. Y.	9.50	4.5	5.50	19.50
New York, N. Y.	9.20	5.6	5.50	20.30
Newark, N. J.	8.70	5.0	4.50	18.20
Philadelphia, Pa.	8.70	4.3	5.50	18.50
Dover, Del.	9.20	4.3	5.50	19.00
Baltimore, Md.	8.45	4.35	5.50	18.30
Washington, D. C.	8.70	4.3	4.50	17.50
Charleston, W. Va.	10.30	4.8	6.50	21.60
Norfolk, Va.	8.70	6.2	6.50	21.30
Charlotte, N. C.	9.80	4.5	7.50	21.80
Charleston, S. C.	9.20	5.0	7.50	21.70
Atlanta, Ga.	10.25	4.25	7.50	22.00
Jacksonville, Fla.	9.50	4.0	8.50	22.00
Birmingham, Ala.	9.75	4.75	*8.50	*23.00
Vicksburg, Miss.	9.25	5.25	7.50	22.00
Memphis, Tenn.	8.90	4.5	8.50	21.90
Lexington, Ky.	10.25	3.75	6.50	20.50
Youngstown, Ohio	9.50	3.0	5.50	18.00
South Bend, Ind.	10.20	2.8	5.50	20.50
Chicago, Ill.	9.60	2.76	4.50	16.86
Detroit, Mich.	9.60	4.08	4.50	18.02
Milwaukee, Wisc.	10.30	4.6	5.50	20.40
Twin Cities, Minn.	10.10	4.8	5.50	20.40
Fargo, N. Dak.	11.10	4.0	5.50	20.60
Huron, S. Dak.	10.50	4.0	5.50	20.00
Omaha, Neb.	9.60	3.0	6.50	19.10
Des Moines, Ia.	9.60	3.6	5.50	18.70
St. Louis, Mo.	9.50	3.0	*4.50	*17.00
Wichita, Kans.	8.60	3.4	5.50	17.50
Tulsa, Okla.	8.00	3.0	9.00	20.00
Little Rock, Ark.	9.20	4.8	8.00	22.00
New Orleans, La.	8.45	4.95	8.50	22.00
Houston, Texas	8.50	4.5	5.50	18.50
Albuquerque, N. Mex.	10.50	4.5	7.00	**22.00
Denver, Colo.	10.00	4.0	5.50	19.50
Casper, Wyo.	11.50	5.0	5.50	22.00
Butte, Mont.	9.50	4.0	6.50	20.00
Boise, Idaho	13.50	4.0	7.50	25.00
Salt Lake City, Utah	13.50	4.5	5.50	23.50
Reno, Nev.	12.00	4.5	5.50	21.50
Phoenix, Ariz.	12.00	4.0	6.50	22.50
San Francisco, Calif.	10.00	4.0	4.50	18.50
Portland, Ore.	10.50	4.0	6.50	21.00
Spokane, Wash.	12.50	4.0	6.50	23.00

* Includes City Tax of $.0100.
** Includes City Tax of $.0050.

Pennsylvania Oils Other Than Lubes at Refineries

(Compiled by National Petroleum Assn. from reports of oil region refiners. Figures in barrels.)

	Mar. 1946	Feb. 1946
Naphthas & Gasoline		
(1) Straight run, unblended and/or unleaded for sale as motor fuel	4,234	4,490
(2) Naphtha and gasoline, for sale for blending or further refining, or held at refinery for further distillation, reforming, blending or leading	309,706	321,736
(3) Below 65 octane, not included in (1) or (2) above	5,956	3,168
(4) 65 octane and above	408,468	399,061
Salable Naphthas other than motor fuel (does not include refinery process naphthas)	21,568	21,178
Kerosine	86,862	52,566
36/40 gas oil (include furnace oil)	54,208	54,205
Fuel oil (not reported above)	32,494	32,298
Oils held as cracking plant charging stocks	246,639	303,750
Non-viscous neutral	23,420	27,134
Wax distillate	74,175	88,888
Crude petrolatum	36,424	38,030
Wax (lbs.)	3,901,093	4,147,147

Net Stocks of Pennsylvania Crude Oil

(Compiled by National Petroleum Assn. Figures in bbls.)

	Mar. 31, 1946	Feb. 28, 1946	Mar. 31, 1945
At Refineries	236,300	245,891	297,500
Pipeline and Tank Farm	1,482,421	1,426,592	1,464,602
Total	1,718,721	1,672,483	1,762,102

Ban Against Using Unions' Funds for Political Purposes Advocated By Indiana Standard Head

Special to NPN

WHITING, Ind.—Standard Oil Co., (Indiana) stockholders at their annual meeting here May 29 were told by Dr. Robert E. Wilson, chairman of the board that "recent crisis and the vigorous, if somewhat belated, action of the President in stopping the rail strike may mark the extreme swing of the pendulum, as did the Boston Police strike after the last war."

"It is, however," he continued, "disturbing to note the head of one of the unions publicly proclaims that they will use, if necessary, all of the $47 million in their treasury to defeat President Truman for re-election. Corporations," he said, "are wisely prohibited from contributing stockholders' money to political campaigns, and effective means should certainly be found to prevent such action by unions, particularly when their funds have been collected for other purposes and might be used for or against candidates without regard for wishes of many of their members."

Dr. Wilson declared, "Our civilization has become far too complex to permit a few individuals to endanger its entire functioning by cutting off in succession our supplies of gasoline, telegraph service, telephone service, transportation and coal, and thus to jeopardize the ability of all of us to earn a living or enjoy the fruits of what our nation could produce."

Of OPA controls over the oil industry, he stated, "In violation of its expressed promises to remove controls in the case of industries in which production capacity exceeds demand, OPA has repeatedly deferred decontrol of the petroleum industry. In this industry," he said, "we have plenty of crude oil, and more refining capacity than is needed to meet current demand."

Accusing the government agency of violation of promises, quibbling, invention of new and flimsy excuses and a display of gross ignorance of the actual situation and of basic facts regarding the operation of the petroleum industry—all these "have made it evident that OPA has no interest in freeing the petroleum industry so it can quickly adjust itself to changing demands and serve consumers fully with all products wanted."

Sharp increase in civilian business was disclosed by Dr. Wilson. Company refineries were operating close to capacity; total sales substantially ahead of 1941 and first-quarter earnings were about the same as first quarter of last year.

Calling attention to company's recent press release of conversion of 200,000 shares of Standard Oil Co. (New Jersey) stock and slightly over 50,000 shares of Consolidated Natural Gas Co. stock into cash for financing $150 million expansion and construction program for 1946, the chairman reported the program "as proceeding under difficulties and cannot be completed this year."

Re-elected directors are: Robert E. Wilson, A. W. Peake, Edward G. Seubert, Max G. Paulus, Harry F. Glair, Judson F. Stone, Roy F. McConnell, Bruce K. Brown, Buell F. Jones, H. E. Hanson, L. C. Welch and F. O. Prior.

Officers of the company, re-elected by directors after stockholders' meeting are: Robert E. Wilson, chairman of the board; A. W. Peake, president; Max G. Paulus, vice president in charge of manufacturing; Roy F. McConnell, vice president in charge of sales; Bruce K. Brown, vice president in charge of development; Buell F. Jones, vice president and general counsel; F. O. Prior, vice president in charge of production; R. J. Lindquist, financial vice president; Ralph E. Clarke, treasurer; Martin A. McNulty, comptroller; Laban E. Harmon, secretary; Walter A. Culin, assistant treasurer; O. M. Perrenot, assistant comptroller; and Samuel K. Botsford and Peter C. Jensen, assistant secretaries.

GASOLINE CONSUMPTION BY STATES, FEBRUARY 1946

	Tax Rate† February Cents	Month of Jan., 1946 Gallons	Month of Feb., 1946 Gallons	Month of Feb., 1945 Gallons	Change %	12 Months Ending With Feb., 1946 Gallons	12 Months Ending With Feb., 1945 Gallons	Change %
Alabama	6	28,328,000	27,645,000	20,223,000	+ 36.70	55,973,000	46,314,000	+20.86
Arizona	5	13,234,000	13,044,000	9,209,000	+ 41.64	26,278,000	18,909,000	+38.97
Arkansas	6½	18,811,000	18,334,000	14,148,000	+ 29.59	37,145,000	30,229,000	+22.88
California	3	221,356,000	226,228,000	185,224,000	+ 22.14	447,584,000	388,620,000	+15.17
Colorado	4	20,925,000	19,736,000	18,694,000	+ 5.57	40,661,000	42,862,000	— 5.14
Connecticut	3	26,104,000	23,997,000	19,469,000	+ 23.26	50,101,000	41,680,000	+20.20
Delaware	4	4,697,000	4,433,000	3,338,000	+ 32.80	9,130,000	6,816,000	+33.95
District of Columbia	3	11,471,000	10,560,000	8,245,000	+ 28.08	22,031,000	17,456,000	+26.21
Florida	7	48,605,000	47,625,000	31,416,000	+ 51.59	96,230,000	65,770,000	+46.31
Georgia	6	41,997,000	40,941,000	29,109,000	+ 40.65	82,938,000	61,418,000	+35.04
Idaho	6	7,649,000	7,598,000	5,905,000	+ 28.67	15,247,000	11,862,000	+28.54
Illinois	3	103,791,000	100,392,000	76,261,000	+ 31.64	204,183,000	159,522,000	+28.00
Indiana	4	62,039,000	54,878,000	51,885,000	+ 5.77	116,917,000	107,206,000	+ 9.06
Iowa	4	43,785,000	42,795,000	32,835,000	+ 30.33	86,580,000	67,708,000	+27.87
Kansas	3	35,630,000	54,621,000	26,934,000	+102.80	90,251,000	57,750,000	+56.28
Kentucky	5	27,848,000	27,564,000	25,684,000	+ 7.32	55,412,000	55,130,000	+ .51
Louisiana	7	27,725,000	26,107,000	22,700,000	+ 15.01	53,832,000	51,919,000	+ 3.68
Maine	4	10,942,000	10,111,000	8,628,000	+ 17.19	21,053,000	18,498,000	+13.81
Maryland	4	26,377,000	23,845,000	23,253,000	+ 2.55	50,222,000	52,294,000	— 3.96
Massachusetts	3	52,506,000	45,289,000	40,343,000	+ 12.26	97,795,000	84,241,000	+16.09
Michigan	3	95,322,000	87,284,000	81,229,000	+ 7.45	182,606,000	171,335,000	+ 6.58
Minnesota	4	41,048,000	36,594,000	28,398,000	+ 28.86	77,642,000	61,157,000	+26.96
Mississippi	6	19,757,000	20,325,000	14,409,000	+ 41.06	40,082,000	32,624,000	+22.86
Missouri	2	*55,797,000	52,451,000	35,495,000	+ 88.78	108,248,000	77,219,000	+40.18
Montana	5	8,830,000	7,973,000	5,900,000	+ 35.14	16,803,000	13,369,000	+25.69
Nebraska	5	21,317,000	20,231,000	14,570,000	+ 38.85	41,548,000	32,743,000	+26.89
Nevada	4	3,623,000	3,802,000	3,100,000	+ 22.65	7,425,000	6,576,000	+12.91
New Hampshire	4	6,450,000	5,982,000	4,837,000	+ 23.67	12,432,000	9,888,000	+25.73
New Jersey	3	63,745,000	61,561,000	51,745,000	+ 18.97	125,306,000	106,278,000	+17.90
New Mexico	5	11,681,000	10,384,000	8,741,000	+ 18.80	22,065,000	17,599,000	+25.88
New York	4	128,358,000	120,137,000	92,275,000	+ 30.19	248,495,000	197,564,000	+25.78
North Carolina	6	47,965,000	42,937,000	31,768,000	+ 35.16	90,902,000	63,536,000	+43.07
North Dakota	4	8,824,000	6,243,000	7,484,000	— 16.58	15,067,000	15,624,000	— 3.57
Ohio	4	112,852,000	98,415,000	93,414,000	+ 5.35	211,267,000	195,040,000	+ 8.32
Oklahoma	7½	35,507,000	35,418,000	41,489,000	— 14.63	70,925,000	89,387,000	—20.65
Oregon	5	23,132,000	23,302,000	16,950,000	+ 37.47	46,434,000	34,280,000	+35.46
Pennsylvania	4	113,475,000	105,948,000	79,309,000	+ 33.59	219,423,000	164,561,000	+33.34
Rhode Island	3	9,018,000	8,551,000	8,691,000	— 1.61	17,569,000	19,650,000	—10.59
South Carolina	6	22,168,000	21,804,000	15,122,000	+ 44.19	43,972,000	31,538,000	+39.43
South Dakota	4	11,254,000	9,039,000	8,591,000	+ 5.21	20,293,000	17,564,000	+15.54
Tennessee	7	32,860,000	31,673,000	27,148,000	+ 16.67	64,533,000	53,147,000	+21.42
Texas	4	178,098,000	155,042,000	340,404,000	— 54.45	333,140,000	756,962,000	—55.99
Utah	4	10,021,000	8,884,000	7,033,000	+ 26.32	18,905,000	15,709,000	+20.35
Vermont	4	4,694,000	4,363,000	2,602,000	+ 67.68	9,057,000	5,911,000	+53.22
Virginia	5	39,940,000	37,741,000	33,149,000	+ 13.85	77,681,000	67,739,000	+14.68
Washington	5	34,281,000	33,811,000	25,932,000	+ 30.33	68,092,000	53,092,000	+28.25
West Virginia	5	19,968,000	16,182,000	13,162,000	+ 22.94	36,150,000	26,704,000	+35.37
Wisconsin	4	47,645,000	39,974,000	31,514,000	+ 26.85	87,619,000	68,302,000	+28.28
Wyoming	4	5,848,000	4,968,000	4,622,000	+ 7.49	10,816,000	11,104,000	— 2.59
Total		2,047,298,000	1,936,762,000	1,782,586,000		3,984,060,000	3,802,406,000	
Daily Average		66,042,000	69,170,000	63,664,000		67,526,000	64,448,000	
Change from previous year:								
Total Change			+154,176,000			+181,654,000		
Percentage change in Daily Average			+8.65%			+4.78%		

* Revised.

† These are State tax rates per gallon. In addition there is the Federal tax of One and one half cents (1½c) per gallon.

CLASSIFIED

For Sale

TANK TRUCK

1941 K-5 International Truck
803 Gal. Heil Tank
2 Closed Bbl. carriers
2″ Lines, Safety Valves

Truck in A-1 condition, all tires prewar recapped, Comp. Sizes 131-133-136-132-141, side tanks 65 gallon each.

THE STERLING PETROLEUM CO.
Mt. Sterling, Ohio

GASOLINE TRANSPORT

One 1940 Semi-Trailer Gasoline Transport—Butler Tank—Fruehauf Axle. Four 11:00 x 20 Tires, Westinghouse Air Brakes—Spare Tire Carrier, Drum Racks. Tank 4200 gallon capacity, three compartments. Price $2200.00 F.O.B. South Bend, Indiana.

CENTRAL WEST OIL CORP.
321 S. Main St., South Bend, Indiana

ALWAYS GET ISP's QUOTATIONS TOO!
USED TANK CAR TANKS
For Liquid Storage
6000 to 10,000 gallons
HEAVIER SAFER CHEAPER
CLEANED TESTED
PAINTED
Also, Vertical Tanks of All Capacities
IRON & STEEL PRODUCTS, INC.
41 years' experience
13456-A S. Brainard Avenue
Chicago 33, Illinois
"ANYTHING containing IRON or STEEL"

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FOR IMMEDIATE DELIVERY

150 gallon Butane Tanks and fittings, also 250 and 500 gallon Propane Tanks and fittings.

FOR DELIVERY IN 30 DAYS

750 gallon and 1000 gallon Propane tanks and fittings.

We also build complete bottling plants.

KENNEY TANK INSTALLATION CO.
2132 N. Halsted St., Chicago 14, Ill.

NEW INTERNATIONAL TRUCKS

Model K8F with K10 Motors

These trucks fully equipped for oil field work. Front mounted winch also Tulsa 25,000 lb. winch back of cab. Tulsa steel platform body with gin poles. Trucks are six wheel drive. Tires 8.25-20. Trucks have canvas cabs.

UDELSON TRUCK SALES

3218 Woodland Ave., Cleveland 15, Ohio

For Sale

STEEL TANKS

285 gallon to 3,000 gallon. Delivery four to six weeks.

EMPIRE EQUIPMENT CORPORATION
608 Empire Bldg., Cleveland 14, Ohio
Phone: Main 7667

Wanted to Buy

SEMI-TANK TRAILER, late model, 2200 to 3,000 gallons, three or four compartments, vacuum brakes. E. J. Fischer Oil Company, 105 Manitoba St., Buffalo 6, N. Y.

TWO, THREE OR FOUR COMPARTMENT semi-trailer of 2600 to 2800 gallon capacity. Will also buy tractor if in good condition. Send photo and price to THE SCHERMERHORN COMPANY, LaSalle, Illinois.

WANTED: OIL BURNER MANUFACTURING BUSINESS

Large Eastern Fuel Oil Company, willing to buy outright or invest funds in oil burner manufacturing business.

BOX 43

STEEL DRUMS

We buy and sell used empty steel drums at any point. Let us have your offerings. We also sell reconditioned drums.

BUCKEYE COOPERAGE COMPANY
3800 Orange Ave. Cleveland 15, Ohio
Phone Express 3383

Positions Wanted

RECOMMENDED by member North Carolina Oil Jobbers Association veteran age 36, married, eight years experience retail and wholesale oil distribution. Last position before entering Army, Bulk plant manager. Desires to purchase small jobbing business or will invest in going business where position is offered. Will also consider position. Box 49.

Positions Wanted

VETERAN with 28 months in South Pacific wants to work for Oil Company, preferably in South America. Will go anywhere for training. Experience in Steel Mills prior to War. Box 44.

VETERAN, 12 years experience marketing petroleum products prior to war, major and independent. Three years station salesman, six years traveling supervisor, three years office in charge of sales and personnel. Age 37, single, will go anywhere. Box 47.

EX NAVAL OFFICER, 33, discharged with honors, seeks new connection, preferably in Southwest, on West Coast, or in Foreign Areas. University eductated, versatile, and of proven managerial and administrative ability. Twelve years of concentrated experience in sales, marketing and distribution, operations, and personnel, with Major, Independent and Government. Present income $6200 annually. Will consider modest investment as limited partner. Box 41.

Situations Open

TECHNICAL GRADUATE

With sufficient engineering experience to qualify for position as office job engineer and assistant Chief Engineer with well-known company specializing in oil refinery engineering and construction. **BOX 36**

SALES MANAGER

Required—Energetic intelligent man age 30-35 with practical knowledge of petroleum products. Preference given those previously engaged in sales capacity and willing to travel. Position offers most attractive future to right party.

BOX 48

Wanted to Buy or Lease

WANTED TO BUY OR LEASE

All types of gasoline service stations in middle west, southwest, and Rocky Mountain territory.

Trackside Stations.

Stations that can and are served by transport tank trucks

Stations that have and can be economically served from bulk storage

Locations must be on heavy traffic flow streets or highways, or in large centers of population.

Box 42

CLASSIFIED

For Lease

FOR LEASE: Well located Bulk Plant, Northern Ohio; 100,000 gallon capacity; Independent Products. Box 46.

Professional Service

ACCURATE LABORATORY TESTS
GASOLINE OIL
Standard Methods Employed
Octane Ratings by A.S.T.M. CFR Unit
THE DETROIT TESTING LABORATORY
554 Bagley Avenue, Detroit 26, Mich.

ANTI-KNOCK VALUES
DETERMINATORS
The Gray Industrial Laboratories
Chemists and Engineers
Specialists on Petroleum Products
961-976 Frelinghuysen Ave.,
NEWARK, N. J.
Telephone Bigelow 3-4020

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On Contract Basis
J. BJORKSTEN, PH. D.
Chemists
BJORKSTEN LABORATORIES
185 N. Wabash Ave. Chicago 1, Ill.

Classified Rates

"For Sale," "Wanted to Buy," "Help Wanted," "Business Opportunities," "Miscellaneous" classifications, set in type this size without border—15 cents a word. Minimum charge, $4.00 per insertion.

"Position Wanted"—10 cents a word. Minimum charge $1.50 per insertion.

Advertisements set in special type or with border—$5.00 per column inch.

Copy must reach us not later than Friday preceding date of issue.

All classified advertisements are payable in advance.

No agency commission or cash discounts on classified Advertisements.

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This index is published as a convenience to the reader. Every care is taken to make it accurate but National Petroleum News assumes no responsibility for errors or omissions.

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Welcome Back

Immer U. Ball, major of engineers in the Army during the war, has written that so many oil men know **Col. D. O. Elliott,** and served under him in pipeline operations, that he is furnishing information concerning the colonel for the Welcome Back page.

Mr. Ball, who entered the Army after 25 years in the mechanical engineering branch of Standard Oil Co. of New Jersey, Louisiana Division is back in Baton Rouge. His activities in the "Med" campaigns were reported from Italy by Editor Warren Platt in the April 11, 1945, issue of NPN.

Mr. Ball has submitted the following information on Col. Elliott, under whom he served:

"I would like to call attention to a regular Army officer of whom the petroleum industry has heard very little, if any, but who was very active in the development of the several pipeline systems. I refer to Col. D. O. Elliott (then Brig. Gen.).

"Col. Elliott was chief engineer of the Mediterranean theater to September, 1944, at which time he returned to the states to assume command of the Engineer Training Command of the Engineer Training Center at Fort Leonard Wood, Mo. On the closing of the Engineer Center at Fort Leonard Wood, Col. Elliott was assigned to the Chicago district as District Engineer, the assignment he now holds.

"Col. Elliott, though not an oil man, realized the value of the pipelines as a means of efficient transportation of gasoline, etc., to both the ground and air forces, and in his capacity of chief engineer for MTO went all out for the development of these lines, and never missed an opportunity to place lines where they were needed."

° ° °

For the sake of this personal item this department should be entitled "The Welcome Over" department instead of "Welcome Back," because it pertains to a well known British petroleum man who served in POL in this war and is now completing a visit to this country.

He is **H. Frank Jones,** late lieutenant colonel of the British Army in the Supply Corps and particularly during all of this war was assistant director of Supplies & Transport for petroleum to **Brigadier Sims** of the British Army who had charge of oil. Most every American oil man who worked in or went through London and Paris during World War II met Col. Jones, then a major, and many of them knew him as an engineer for years with the Anglo-American Oil Co. of London a Standard of New Jersey subsidiary, and particularly with its marine department. He is now in an executive position with the British Mexican Oil Co. an allied Anglo-American concern.

Lt. Colonel Jones worked with American Army and Navy POL officers in connection with the many big oil "dumps" about England prior to the French invasion and with them in Paris, Antwerp and other European military supply headquarters after the invasion. Colonel Jones went through all of the North African campaign with the British Army, returning to London in time to aid in the preparations for the Continental invasion across the channel.

Colonel Jones enlisted in the British Army in the first war when he was not yet 18. He served as a private and was assigned to about the first armored tank sent to France. He fought throughout the war. Just before its close his driver was killed and his tank knocked out and he taken prisoner by the Germans.

Colonel Jones with Mrs. Jones has been making a quick trip to his company's affiliates in this country and to the Imperial Oil Co.'s refinery at Sarnia, Ont. They are sailing for England June 20th on the Queen Mary.

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ABOUT OIL PEOPLE

Harry B. Knisely, Tulsa, has been named head of the newly formed public relations department of Sunray Oil Corp. to succeed **Leatrice Hollenbeck,** who resigned as head of the Information Dept. and editorial director of *Sunray News.*

New Sunray department will incorporate information service previously handled by Miss Hollenbeck and will be expanded to include various other phases of public relations activities. **Elbert Patterson** will continue as editor of *Sunray News,* company magazine.

Mr. Knisely was director of public relations for Spartan School of Aeronautics before he joined the public relations staff of the Carter Oil Company in 1943. He has served as editor of *The Link,* Carter magazine, president of Southwestern Assn. of Industrial Editors and recently was named a vice president of International Council of Industrial Editors.

Miss Hollenbeck has been with Sunray about 13 years. Her first job in 1933 was that of secretary to **W. D. Forster,** corporation secretary. Since 1937 she has been secretary to **President C. H. Wright.** In that year she initiated the *Sunray News,* and remained its editor until 1944. In 1943 Sunray loaned her to PAW to fill a special assignment on aviation gasoline publicity and spent the following year on leave as research analyst for American Petroleum Institute. She is planning an extensive travel tour through Central and South America before entering University of California next fall for special studies in journalism.

° ° °

Don Harlan, assistant division petroleum engineer for the West Texas-New Mexico division for The Texas Co., has been promoted and transferred to the Houston office of the company. He will be on the staff of **Dr. W. V. Vietti,** who is in charge of the company's petroleum engineering, gas and natural gasoline.

° ° °

Paul H. Ledyard has been named vice president of Southern Geophysical Co. with offices in the Sinclair Building, Fort Worth. He is a graduate of California Institute of Technology and was with Stanolind Oil and Gas Co. for 10 years before joining Southern.

° ° °

Harry W. LaFleur has been appointed manager of lubricating oil sales for Sinclair Refining Co.'s central district comprising the states of Illinois, Indiana, Michigan, Ohio and Wisconsin.

Mr. LaFleur previously was manager of lubricating oil sales for Michigan with headquarters in Detroit and prior to that was in Columbus, O. He joined Sinclair in 1922 as a salesman in Ohio.

Col. B. B. Talley, U. S. district engineer, Huntington, W. Va., was guest speaker at the Cincinnati Oil Club, at the Cincinnati Club, on May 16.

Col. Talley, who served five years overseas, took the group for an exciting whirl around the world telling of some of his war experiences.

Date for the club's annual picnic was set for June 20 at the Summit Hills Country Club. All indications point to a record attendance.

° ° °

Sam J. Larson, assistant division manager, Continental Oil Co., Ponca City, Okla., has been appointed division manager, Albuquerque, succeeding **W. B. Elliott** who was recently made agent at El Paso.

Jack J. Nemeth, city manager, Kansas City, has been made assistant division manager at Ponca City, succeding Mr. Larson.

Replacing **W. O. Fuller,** who resigned as assistant division manager at Ponca City, is **James A. Doctor,** district sales representative at Norfolk, Nebr.

H. E. Robbins, city manager, Omaha, has been named assistant division manager at Fort Worth, filling the position previously held by **T. H. Joyce,** who was tranferred with the 45 Texas agencies to the Albuquerque division.

Other Continental marketing personnel changes include:

Fred H. Schindel, city manager, Des Moines, becomes assistant division manager, Lincoln, succeeding **W. R. Fitzpatrick,** who was recently made division manager there.

Clifford G. Haller, city manager, Chicago, appointed assistant division manager, Chicago, succeeding **J. L. Wait,** newly appointed manager of the division.

Dean Hadfield, city manager, Salt Lake City, named assistant manager, Salt Lake division, when **L. R. Kump** was made division manager.

William G. Callaway, district sales representative, Great Falls, Mont., named assistant division manager, Butte division, replacing **L. A. Whittaker,** who retires under the company's retirement annuity benefit plan.

Charles W. Gentry, traffic clerk, Ponca City, appointed assistant manager, railway sales, Chicago, the position held by **E. F. Shannon** before his promotion to be manager of that division.

H. Russell Richards, cost-distribution-budget clerk, order and distribution division, made assistant superintendent of the division following **G. H. Lovejoy's** appointment as superintendent.

° ° °

A. B. Penny of Humble Oil & Refining Co. has been elected president of Houston Advertising Club.

COMING MEETINGS

JUNE

American Petroleum Institute, Production Division, spring meeting, William Penn Hotel Pittsburgh, Pa., June 13-14.

Wisconsin Petroleum Assn., annual golf tournament, Lake Delton, Wis., June 18.

New Jersey Oil Trade Assn., Inc., annual golf tournament, Suburban Golf Club, Union, N. J., June 20.

Western Petroleum Refiners Assn., regional technical meeting, Olds Hotel, Lansing, Mich., June 20.

Virginia Oil Jobbers Assn., spring convention, Richmond, Va., June 20-21.

Virginia Oil Men's Assn., spring convention, Jefferson Hotel, Richmond, Va., June 20-21.

Oil Heat Institute of New England, annual exposition, Hotel Statler, Boston, June 24-27.

Pennsylvania Grade Crude Oil Assn., annual meeting, William Penn Hotel, Pittsburgh, June 27-28.

JULY

American Petroleum Institute, regional meeting, Division of Marketing, Denver, Colo., July 10.

AUGUST

Interstate Oil Compact Commission, summer quarterly meeting, Pantlind Hotel, Grand Rapids, Mich., Aug. 8-10.

Society of Automotive Engineers, West Coast Transportation & Maintenance meeting, Hotel New Washington, Seattle, Wash., Aug. 22-24.

SEPTEMBER

Chicago Section, American Chemical Society, Coliseum, Chicago, Sept. 10-14.

Society of Automotive Engineers, Tractor Meeting, Hotel Schroeder, Milwaukee, Wis., Sept. 11-12.

National Petroleum Assn., 44th annual meeting, Hotel Traymore, Atlantic City, N. J., Sept. 18-20.

National Butane-Propane Assn., annual convention, Continental Hotel, Chicago, Sept. 23-25.

Indiana Independent Petroleum Assn., fall convention, Hotel Severin, Indianapolis, Sept. 26-27.

National Lubricating Grease Institute, 14th annual meeting, Edgewater Beach Hotel, Chicago, Sept. 29-Oct. 2.

OCTOBER

American Assn. of Oilwell Drilling Contractors, annual meeting, Plaza Hotel, San Antonio, Tex., Oct. 1-2.

Society of Automotive Engineers, Aeronautic (Autumn) & Aircraft Engineering Display, Hotel Biltmore, Los Angeles, Oct. 3-5.

American Institute of Mining & Metallurgical Engineers, Petroleum Division, annual meeting, Galvez Hotel, Galveston, Tex., Oct. 3-5.

Society of Automotive Engineers, Transportation and Maintenance Meeting, Hotel Knickerbocker, Chicago, Oct. 16-17.

American Institute of Mining & Metallurgical Engineers, Petroleum Division, Ambassador Hotel, Los Angeles, Oct. 24-25.

Independent Petroleum Assn. of America, annual meeting, Fort Worth, Oct. 28-30.

NOVEMBER

Petroleum Division, National Assn. of Credit Men, annual convention, William Penn Hotel, Pittsburgh, Nov. 4-5-6.

American Petroleum Institute, annual convention, Stevens Hotel, Chicago, Nov. 11-14.

DECEMBER

Society of Automotive Engineers, Air Transport Engineering Meeting, Edgewater Beach Hotel, Chicago, Dec. 2-4.

MARCH, 1947

Indiana Independent Petroleum Assn., spring meeting, Hotel Severin, Indianapolis, March 13-14, 1947.

WHICH IS IT —

A 1941 or 1946 Model?

In 1941 one of our customers ordered the 2500 gallon, 6-compartment, gasoline tank shown above. He has been so well pleased with the service obtained from it that he recently re-ordered. It would seem from this —one of many such examples—that FARRELL design and engineering are so outstanding that few changes are desirable even in these post-war days. Needless to say, however, all that we learned during the war has gone into this new tank. But the fundamental principles are the same today as they were when we built the above tank, which might easily be taken as a twin of the 1946 model. Your inquiries are always welcome and cordially invited.

FARRELL MFG. COMPANY

Joliet, Illinois

SUN GREASES . . .

Provide a Complete Line of Long-Lasting, Extra-Profit Lubricants

Grease sales are extra business, extra profit. And Sun offers a complete line of more than sixty greases and bases to provide the maximum in wear-protection for chassis, transmission, differential, or special lubrication-job.

Sell these time-tested greases and lubricants for cars, trucks, or buses under your own brand, and you can help keep machines in action, protect them against excessive wear, high maintenance-charges, premature break-down.

Sun Chassis Lubricants can be used for hand-gun or piping-systems. Summer or Winter, they resist channeling, hardening, separating, or washing. They stand up under high pressures, high temperatures.

Sun Transmission Lubricants provide a tough, durable protective film for gear-teeth. They are available in Winter and Summer grades, for maximum protection, easy shifting at all temperatures.

Sun Differential Lubricants are made in regular, E.P., and Hypoid grades to furnish reliable, long-lasting lubrication for every type of automotive differential.

Sun Special Lubricants are scientifically prepared for the particular applications like universal joints, where greases must bear heavy pressures and resist the tendency to be thrown off; for water-pumps, where absolute resistance to washing-action is necessary; for wheel-bearings, steering-gears, etc.

For complete information, call the Sun office near you, or write direct to . . .

SUN OIL COMPANY · *Philadelphia 3, Pa.*

SUN *Pre-Tested* LUBRICANTS

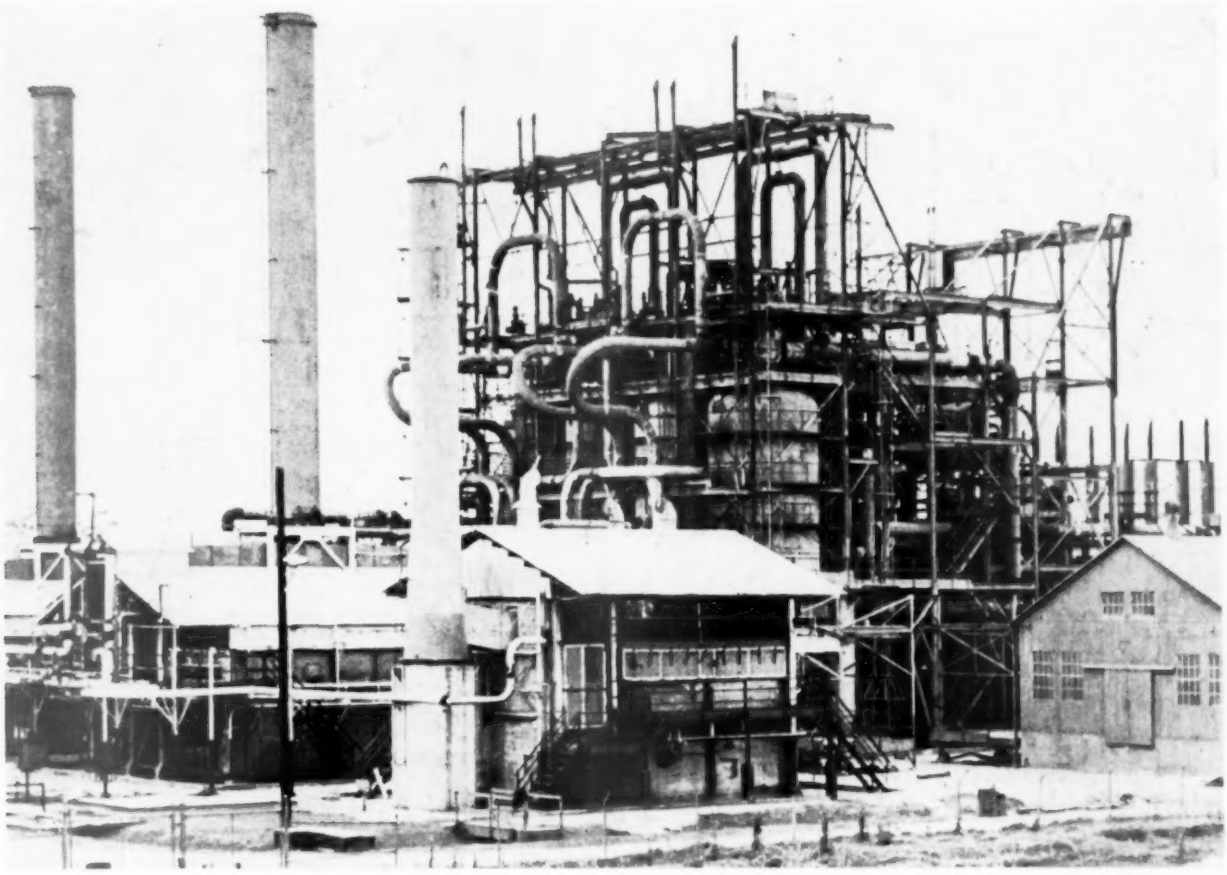
A complete line of Finished Oils, Blending Oils and more than 60 Greases and Bases

NATIONAL PETROLEUM NEWS

Monthly Technical Section Devoted to

REFINERY MANAGEMENT and PETROLEUM CHEMICAL TECHNOLOGY

Section Two | June 5, 1946 | Vol. 38, No. 23



NATION'S LARGEST HYDROFORMER

The above plant at Baytown, Texas, is operated by Humble Oil & Refining Co. Having a design capacity of 16,500 b/d it employs three separate furnaces, because of the heavy duty required, in place of a combination furnace. Compressor house and two furnaces are shown in foreground, four reactors in rear

Hydroforming Naphthas Produces Higher Octane Motor Gasoline R-456

"Tech Service" Pays Out in More Efficient Refinery Planning R-403

Eliminating Equipment Bottlenecks Boosts Unit Output Six-Fold R-411

Glycol Dehydration Plant Reduces Dew Point of Gas by 50° R-421

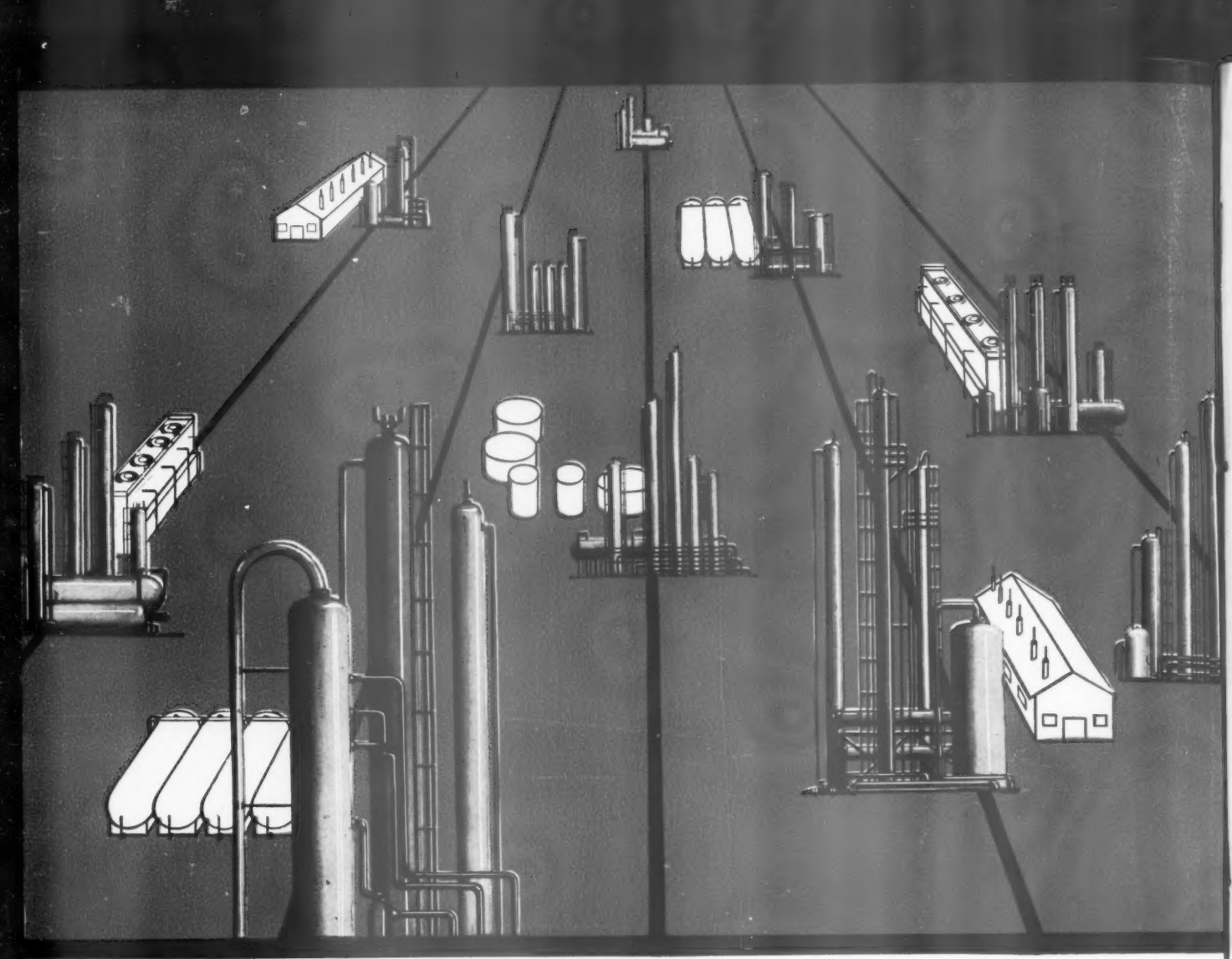
Waste Oils Escaping from Refineries Can Cause Many Kinds of Damage R-467

New Methods for Fighting Corrosion of Buried Equipment, Pipelines R-450

How Germans Used Fischer-Tropsch Process to Make Fuels, Chemicals R-425

PLANT PRACTICES

New type spring-loaded pipe scraper permits more efficient wax removal . . . ingenious placement of welding equipment saves space in fabricating shops . . . chemical cleaning method for gauge glasses is safer and faster . . . manifolded gauge tester permits quicker, more accurate checking of pressure gauges . . . pneumatic pipe straightener built from salvaged freight car brake cylinder R-416



Avenues of Progress

Hudson personnel has specialized in process design from the early days of single product absorption gasoline plants, when a plant processing 12 million feet daily was considered a large project, to the present era of high pressure plants in unitized fields, processing up to 350 million feet daily and producing as many as nine different liquid products.

The total gas capacity of Hudson-designed plants in operation or under construction exceeds two billion standard cubic feet daily.

GAS COMPRESSOR STATIONS • CYCLING PLANTS • GAS DEHYDRATION PLANTS • NATURAL GASOLINE PLANTS • FRACTIONATION UNITS • CRUDE TOPPING UNITS • PRESSURE MAINTENANCE PLANTS • HYDROGEN SULPHIDE REMOVAL PLANTS • ATMOSPHERIC AND VACUUM DISTILLATION UNITS

HUDSON ENGINEERING CORPORATION

Engineers and Constructors

FAIRVIEW STATION • HOUSTON, TEXAS

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"Oil Companies Can Help Research Staffs to Find Their Voice"
"Salute to a New Technical Society"

★ *EXCLUSIVE* in the NPN Technical Section

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PREVIEW

OF JULY FEATURES

Southwest Refiner Enters Petrochemical Field

Lion Oil Co. has taken by long term lease the government munitions plant near El Dorado, Ark., which produced ammonia and ammonium nitrate from natural gas for explosives during the war. It will be immediately operated to produce ammonia and nitrogen fertilizer materials which are vital to agriculture in increasing food production. Future plans call for the production of various chemicals, in addition to ammonia, used in the manufacture of plastics, textiles, solvents, pharmaceuticals, detergents and so on.

While the new peacetime manufacture of chemicals by this southwest refiner started only May 13, an NPN Technical Section staff writer a few months before had visited the Ozark Ordnance Works and studied the plans to convert to this new type of operation. His article appears exclusively in the July 3d issue.

Design of Instrumentation For a Fractionating Tower

Fractionating towers designed to separate the products of modern catalytic cracking units must take into account two factors: (1) operation at relatively high temperatures and (2) carryover of catalyst into the tower (unless the unit is of the fixed-bed type).

In addition, if the refiner is to be able to take full advantage of the flexibility of his cracking unit to meet varying crude stocks and market demands, the fractionator should be designed to provide a corresponding flexibility in separating products.

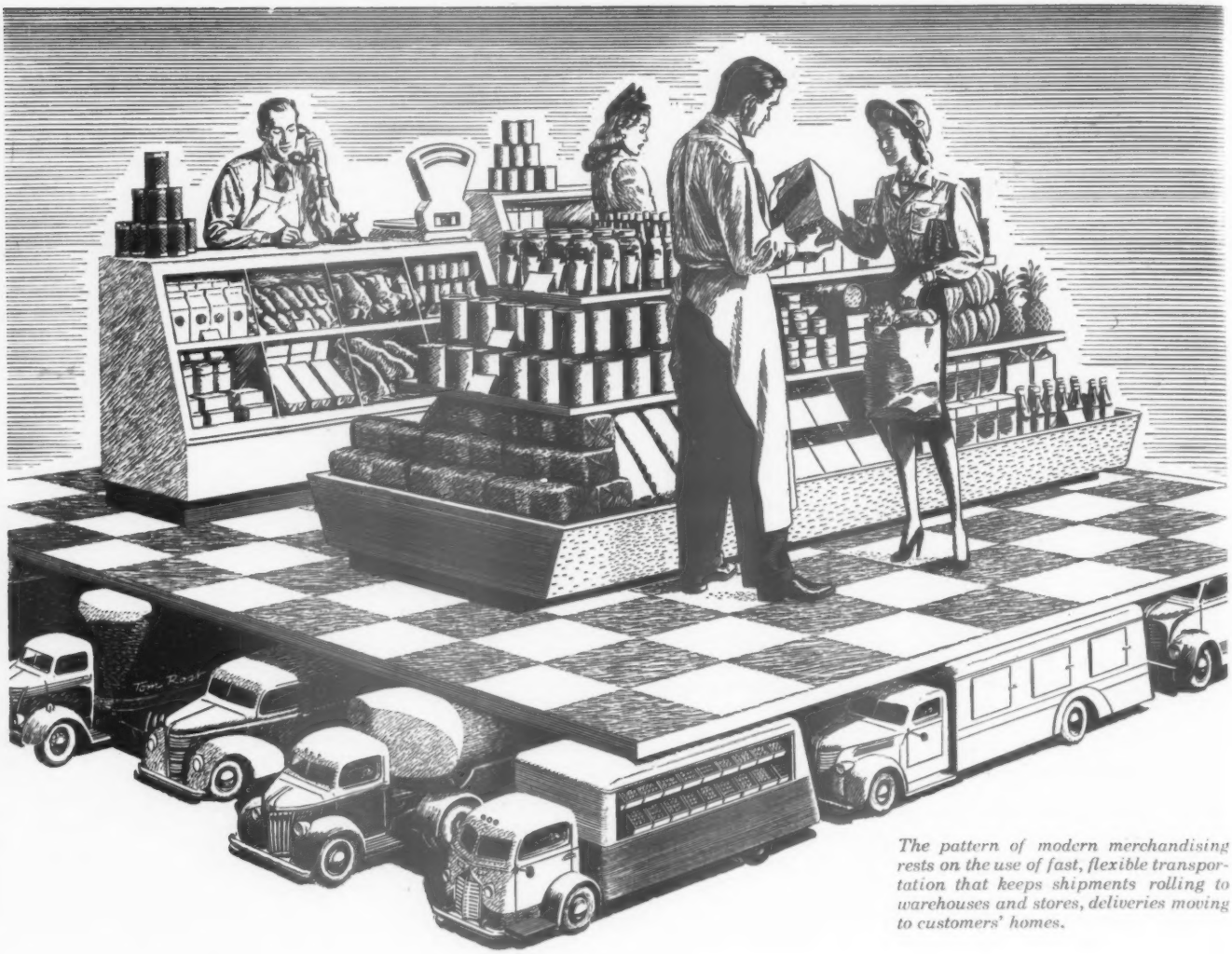
Complete instrumentation is the answer. Engineers with one of the major instrument companies tell in the next issue how they designed the instrumentation for such a tower, what factors influenced their design, and what its economic advantages are.

Spectrographic Analysis

The article on spectrographic methods of analysis of additive type lubricants which was originally scheduled for publication in the current June 5 issue will appear in the July 3 issue instead.

Chemicals from Propane

An authority from the chemical field discusses the manufacture of chemicals from light hydrocarbon fractions. He limits himself to one hydrocarbon, propane, and to a few of the better known products derived from propane, thus emphasizing, stronger than words can, the wide possibilities as to the potential petrochemical field. He also considers the economic factors affecting the marketing of a new chemical.



The pattern of modern merchandising rests on the use of fast, flexible transportation that keeps shipments rolling to warehouses and stores, deliveries moving to customers' homes.

Modern merchandising is built on gasoline

THERE is hardly a business that doesn't depend on automotive transportation. The dairy and bakery industries are built on it. Groceries, laundries and countless other businesses thrive on it. And *all* business benefits when transportation is improved by the development of better engines and better gasoline.

For over twenty years oil refiners have been using Ethyl antiknock fluid to help produce increasingly better gasolines. Each improvement in gasoline quality has made possible the design of more powerful, more efficient engines. In turn, this combination of better engines and better gasolines has helped to lower transportation costs.

Because fuels, engines and lubricants are so closely related in use and development, Ethyl engineers have always worked closely with the technical people of petroleum and automotive companies. Today we are expanding our research and service facilities still further so that we shall be able to offer more help than ever in the big, overall job of providing better, more economical transportation for everyone. Ethyl Corporation, Chrysler Building, New York 17, New York.

More power from every gallon of gasoline through

ETHYL

Research · Service · Products

R-402

REFINERY MANAGEMENT *and* PETROLEUM CHEMICAL TECHNOLOGY

June 5, 1946
Volume 38
Number 23

MONTHLY TECHNICAL SECTION OF NATIONAL PETROLEUM NEWS *incorporating International Petroleum Technology*

TECHNICAL SERVICE PAYS ITS WAY

Even in Smaller Refineries New Functions are Being Found for the Technical Groups First Organized as a Liaison Between Professional Engineers and the Plant Operating Force

"TECH Service," the technical consultant of the modern refinery, in many instances more than pays for its keep, although it is a straight staff organization having no direct part in plant operation.

Its usefulness in long range planning and in the study of major operating problems is increasing in proportion with the intricacy of refinery processing. Technical Service groups are being set up in the smaller refineries, where the staff may be no more than one man, with perhaps an assistant and a small amount of clerical help. In the larger plants the staffs of engineers, chemical engineers and in a few cases physicists are being enlarged.

This practical side of the function of "Tech Service" today tends to overshadow the original purpose for which these groups were installed in refinery organizations some 15 or 20 years ago. This was to provide a means for liaison between the professionl engineers and the plant operating force. They served as a training ground for the young engineers fresh from school and without practical industrial experience. Being on the staff of Technical Service gave them a status and responsibilities which the young engineer could not command as an individual.

This liaison function is even more important today, in the general shortage of new professionally trained men due to their being drafted during the war. It makes it possible for the refining company to make the most efficient use not only of the few young men they get fresh from college, but of their entire engineering staffs.

From their training in Technical Service, individuals are advanced to plant operating duties. By this means the company is assured of placing technically trained men, with some experience in plant operation and in handling men, in key posts in its processing units.

The practical functions of Technical Service are many fold, but they have at least two points in common. First, they are entirely advisory or servicing and not permanently a part of any actual plant operation. Second, they are long range by nature, anticipating conditions and planning changes for months or even years ahead. Here they differ from the duties of the process engineers in some plants, who are the technical watchdogs of daily operations.

"Tech Service" Functions

Among the functions of Technical Service is the running of acceptance tests on new equipment. It also tries out, by installing a sample in the plant, a new type of pump or motor a manufacturer is offering. If the performance of a processing unit is not up to standard and the reason is not at once apparent, its men are called to look into the matter. It supervises the break-in of new units and teaches the plant operators the special technique of operating them, sometimes with the help of licensor engineers.

It works out months ahead of the need details of changes in plant operations to meet new product requirements, or a new type of crude to be run. If the company has a Research and Development Department, it takes the ideas on new products or methods worked out there experimentally and studies their commercial application. Its representatives are called in when complaints of product quality come from important sources.

The cost of Technical Service, since it is a staff organization, is mainly in salaries. This cost ranges from 1 to 2% of refinery payroll, according to several companies interviewed by NPN's Technical Section. Many instances can be cited to show how value has been returned to the company, far more than the entire cost of its Technical Service.

For example, during the war, one large refinery was catalytically cracking its light gas oils and thermally cracking the heavier gas oils to assure maximum production of 100-octane aviation gasoline components. When it shifted back to motor fuel production after V-J day, the Technical Service group, as a result of previous study of basic factors, recommended exactly a reverse procedure as more attractive economically.

"It took a group detached from actual plant operations, with time, data and the background knowledge for such studies to determine that the value to the refinery of the change would amount to around $4000 a day, or $1,500,000 annually" said the refinery manager.

In another refinery, the Technical Service group discovered, soon after a catalytic cracking unit went on stream, that the factor setting the throughput rate was the carbon-burning capacity of the regenerator. It recommended a method for providing additional capacity which increased throughput rate materially.

In another instance, in connection with the installation of a new catalytic cracking unit, design changes in the gas recovery plant were worked out which greatly increased the yield of liquid products. While the changes cost over $500,000, this cost was paid out in three years.

Refiners interviewed, were asked what was the minimum size refinery that could economically maintain a Technical Service group in its organizational setup. There seems to be no bottom limit. Some said that every refiner, in effect if not in name, has a Technical Service group, since they will call on their chief

The accompanying article, as far as is known, gives the first detailed data to be published on the organization and functions in refineries of Technical Service sections. Data for the article was secured through studies made by NPN Technical Section's representatives, of seven refinery organizations.

chemist or chief engineer from time to time to engage in experimental work. In such cases, it was said the routine duties in plant operation of the individual are affected. Also by nature of his regular duties he does not have the detached point of view and the time required to secure the best results from experimental studies.

In general, for small companies, it was stated a Technical Service group should have at least two, possibly three, chemical engineers plus the necessary clerical help. The cost could be kept to under 2% of total payroll cost and would be mainly salaries and travel expense. Some refiners said a Technical Service group was more important than a Research Department, if both could not be supported.

A good way for a small company to start a Technical Service Department, an Oklahoma refiner suggests, is to head it up with one of its technically-trained men, either an engineer or a chemist who has had extensive experience with the plant's operation and control. He should be freed from all routine duties in connection with plant operation so he can give full attention to the solving of processing problems. He should have at least one assistant to aid in collecting plant data and to do limited experimental work. The control laboratory can usually be called upon for assistance in testing and experimental programs.

To secure full co-operation between this department and the departments which it will serve, a clear-cut line of Technical Service functions, duties and responsibilities should be given all department heads and foremen. The distinction between Technical Service, control testing and plant engineering should be clearly understood. The latter two engage in work required to maintain day-to-day manufacturing schedules. The former has as its primary function the solution of problems of a technical nature encountered in processing, in product improvement or development and in setting up new processes.

Below are given the details of organization and functions of the Technical Service groups or divisions of 7 oil companies in various parts of the country as secured by interviews with the individuals directing their work. Mostly these are large oil companies. However, it is believed from these examples that smaller refineries then determine how the principle of a Technical Service group can be applied in their own organization.

Company No. 1

(Crude charging capacity over 150,000 b/d)

Technical Service is a sub-group of the Technical and Research Division, the manager of which division ranks equally with plant superintendents (See Fig. 1). At present Technical Service totals 61 people, 54 engineers and 7 clerical or non-technical workers. Its prime function is that of a staff organization, and includes making economic studies of current and projected operations; assisting the operating department in trouble shooting; co-operating with engineering and operating departments in the selection, installation and break-in of new units or equipment, and assisting research in planning development work.

With one or two exceptions all Technical Service personnel are graduate engineers. Most of the men are chemical engineers, one or two mechanicals. Many also have a Master's degree in chemical engineering, chemistry or physics; a substantial number have completed their doctorate.

Professional personnel is divided into seven sections. A clerical group forms the eighth. These sections are assigned to the appropriate division of the refinery as indicated in Fig. 1; butadiene, butyl rubber, cracking and polymerization, distillation and light ends, economic analysis, treating, and operation analysis. Responsibility of the sections is to study the operations of the unit to which they are assigned. They watch for "bottlenecks" in operation to determine ways in which efficiency or throughput can be increased. They advise the operating personnel during starting-up and shutdown, but have no responsibilities during unit turn-arounds.

Under no circumstances may any member of Technical Service issue orders concerning any operation, or perform any operating duties. However, they are free to make recommendations to the supervisory personnel. Generally they transact most of their business with the foreman in charge of the unit. If the nature of the recommendation is such that the foreman does not wish to or cannot accept responsibility, it may go to the superintendent involved or to the plant committee, composed of superintendent and major department heads (including Technical Service). The recommendation might even reach the manufacturing committee, representing top management of the company.

Technical Service has the responsibility of furnishing process flow-sheets (schematic) and material balances on all new installations. On the latter are indicated the operating conditions, such as temperature, pressure and flow rates; heat duty on furnaces, exchangers, reboilers and the like, plus a general heat balance for the entire operation. Generally the approximate type and size of equipment is indicated also. Data then are forwarded to the engineering department for actual design, but here again Technical Service as well as Research and Development may be called upon for consultation. The operating department will be called in for suggestions as to layout, particularly to foresee operating convenience.

In this company, the cost of Technical Service is salaries, travel expense and other incidentals of a non-operating division. Finances are provided for in the operating budget of the Technical and Research Division. The budget is approved by the manager of the Technical and Research Division, the director of refining and, ultimately, the board of directors. The budget for Technical Service is 1.5 to 2% of the payroll of the company's largest refinery.

Company No. 2

(Crude charging capacity around 30,000 b/d)

This company has no Technical Service department as such. However, it has one chemical engineer exclusively assigned to process work with another engineer as assistant. His duties are to follow plant operations for their improvement and trouble-shoot as required. In case of major difficulties, process licensors are called in. In the organization setup the process engineer reports to the assistant superintendent. As in most other companies the process engineer has no authority over plant operations and acts solely in an advisory capacity. Expense involved is the salary of the two men, provided out of the plant operations budget.

Where changes require alteration of existing equipment or installation of new items, the process engineer is in charge of determining heat balances and other data. The actual mechanical design is handled by the engineering department, although the process engineer may per-

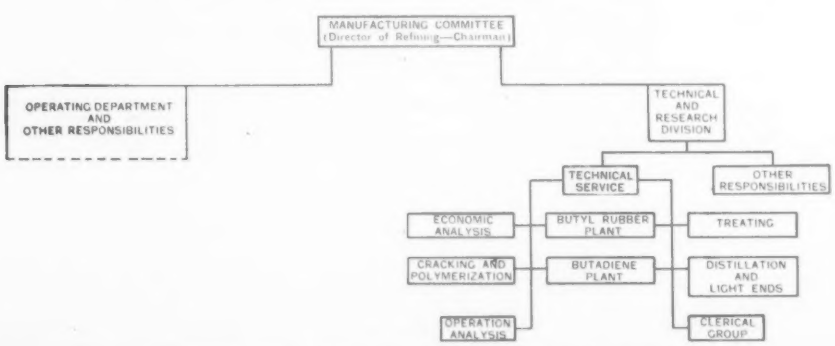


Fig. 1—Organization of Company No. 1, over 150,000 b/d capacity

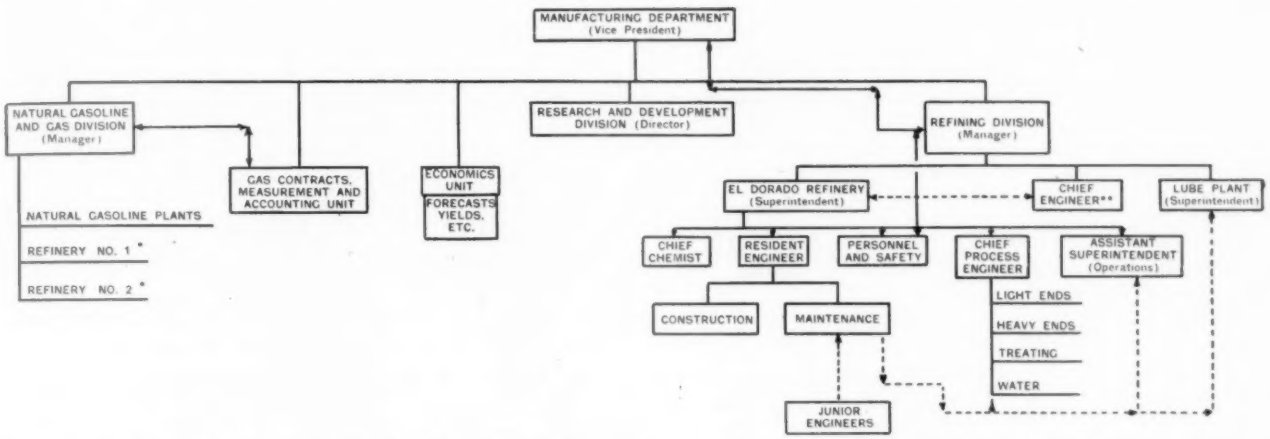


Fig. 2—Organization of Company No. 3, under 40,000 b/d capacity. Technical Service is under the Chief Process Engineer

form a part of this work and function in an advisory capacity also. Process work on any contemplated addition to the refinery is handled by the process engineer in conjunction with the management. In case of a major addition, this would largely be an advisory function, with actual design left up to the contractor or process licensor, after the type of process had been decided upon by company management.

Company No. 3

(Crude charging capacity under 40,000 b/d)

Technical Service, for a Mid-continent oil company, is carried on by a Process Engineering Department in its largest plant. It now contains five men, all chemical engineers by training and experience. All have had practical operating experience in the plant. Future recruits to this department and also the engineering department, with which it has equal rank, for the most part will come from young engineers out of technical schools. These men, hired as junior engineers, actually start work as laborers, being advanced through plant maintenance crews and then in plant operations, before going into the engineering or process engineering departments.

The Process Engineering department, similarly to its counterpart in other companies, has no authority over the operating department personnel or individual plant managers. The engineers on its staff take up most matters directly with the plant foremen. This simplifies work. The chief process engineer takes up matters directly with the assistant superintendent of the refinery or the lubricating oil plant, who may issue an order immediately to an operating foreman. Major problems, unless immediate, await the weekly conference of the superintendent's staff, of which the chief process engineer is a member.

Funds for the Process Engineering department come directly from the regular refinery budget. Expense is entirely for salaries, since no pilot plant or laboratory work is done by this group, but is entirely handled by the Research and Development Department.

Principal Functions

The Process Engineering department has these principal functions: to check plant operations and to recommend improvements, and to make heat balances for proposed operations or changes and check the engineering department's over-all calculations. As a general rule it is not concerned with inspection or maintenance. However, should a special problem develop with a certain unit, necessitating a shutdown, a representative would be present when the unit comes down for whatever information he might obtain.

There is no question in management's mind that Process Engineering pays its keep. In fact it is to be enlarged shortly. There are any number of instances on record where a product was improved by its suggestions or a saving of a fractional cent achieved in processing costs.

Organization Is Unusual

The organization chart for this company, Fig. 2, is unusual in that so many functions are concentrated under a single vice president. The economics unit, for example, while reporting directly to the vice president, handles the balance sheets on determination of refinery and natural gasoline plant yields, forecasts income and makes forecasts of yields from future operations. The economics unit is a very important element with this company.

In this company the chief chemist, chief engineer, chief process engineer, personnel and safety director and assistant superintendent form the superintendent's staff. Meetings are held at least once a week. Problems which the individual department head cannot settle are threshed out in these meetings.

Technical co-ordination is achieved through still another committee, meeting at least quarterly, of which the vice president in charge of manufacturing is chairman. This committee draws its membership entirely from within the refining department and represents all divisions and units. The function of this committee is entirely advisory and concerns the refining department's technical problems.

Company No. 4

(Crude charging capacity around 100,000 b/d)

At the principal refinery of another large oil company, Technical Service is one of four groups of the Chemical Engineering Division of the Research Department. The four are: Technical Service, Process Design, Exploratory Economics and Co-ordination and Economics. All are under an assistant director of the Research Department.

Technical Service is the largest with a personnel of 14 men. All are chemical engineers, some with a master's or doctor's degree. The head of the groups ranks in the organization setup with assistant department heads in the plant. The cost of Technical Service is largely salaries and is approximately 1% of refinery payroll.

Duties of Technical Service in this plant are confined to following operations of the individual units, trouble-shooting, running efficiency tests on units from time to time and calculating yields and product quality.

Technical Service representatives are not permanently attached to any one refinery unit, are regularly rotated from job to job and may be concentrated at a single unit or section of the refinery as the need requires. One man may have several units as his responsibility or only one unit. This flexibility of operation has the advantage (1) of assuring that each member of Technical Service will become acquainted with the entire refinery and (2) as many men can be usefully concentrated at one spot as may be required by a given situation.

Since the Technical Service staff follows the operation of units closely, incipient signs of trouble frequently can be picked up and the correction made without interrupting operations. The men shortly become so familiar with a

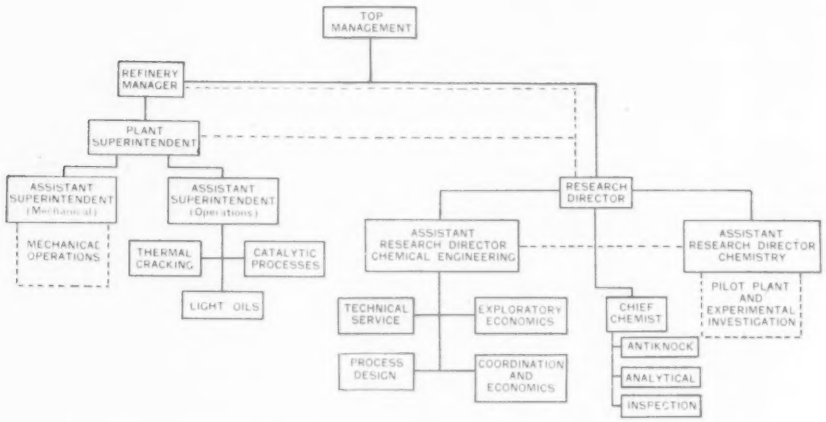


Fig. 3—Organization of Company No. 4, capacity around 100,000 b/d

unit that oftentimes they can foretell with accuracy what it will do under given conditions, hence are especially adept at spotting bottlenecks.

Each week individual conferences are held between the head of Technical Service, the head of Co-ordination and Economics, the assistant director of research and one of the three plant department heads, in the presence of the assistant superintendent in charge of refinery operation. This group of five is small enough to work out mutual problems concerning that particular operating department and rarely has to refer a subject "through channels."

Referring to the organization chart of this company, Fig. 3, there are two other divisions of the Research Department in addition to the Chemical Engineering Division, of which Technical Service is part. These are Chemical Research and Control Laboratory (Chief Chemist) each under an assistant director of the Research Department.

Duties of Chemical Research

Chemical Research concerns itself with pilot plant and experimental investigations. In other companies this activity would be classified as research and development proper, for it combines pure research with pilot plant scale demonstrations. The Control Laboratory Division, under a chief chemist, is divided into three parts: antiknock, analytical testing and control inspection.

The director of the Research Department ranks in the organization setup with an assistant plant superintendent. The assistant directors, including that of Technical Service, rank above the chief chemist and equal with plant department heads.

The Research Department for this company operates under no fixed budget, contrary to the policy in many companies and this applies also to its various subdivisions, including Technical Service. The groups increase or reduce their manpower for the work in hand. When a major expansion becomes necessary it is cleared with the top management of the company.

Company No. 5

(Crude charging capacity around 90,000 b/d)

In a midwestern oil company with several refineries, Technical Service is a section of Development & Process, which in turn is one of the five divisions of the Manufacturing Department, which is headed by a company vice-president. As shown in Fig. 4, the five divisions are Engineering (general), Personnel, Pure Research (chemical), Development & Process, and the several refineries considered as a group.

The other sections of Development and Research, in addition to Technical Service, are Products Service and Refinery Co-ordination.

Products Service handles technical problems concerning finished products, both as to their constituents and in the light of customer complaints referred to it by other major departments of the company. In other words, it serves a liaison between manufacturing and sales organization.

Refinery Co-ordination, on the other hand, serves in a staff capacity to co-ordinate the operations of the various refineries so that, in effect, they operate as a single plant. It combines economics with management of the plant and advises the manufacturing Department manager of its findings.

All sections and subsections, as well as major divisions, report through their chiefs to the Refining Department manager, who exercises direct control as well as "through channels" supervision. Only in cases where for flexibility the refinery manager has delegated specific authority, can any of the staff organization exercise anything approximating direct control.

The function of Technical Service is to serve all the refineries as an advisory and service group, but at the same time it does not have any personnel permanently assigned to any specific plant or operating unit. It operates solely as a staff organization, combining process engineering with commercial operation, hence has no operating responsibilities or authority to order any kind of operational changes.

Personnel is largely professionally trained and experienced chemical engineers and chemists with a sprinkling of mechanical engineers, assisted by non-technically trained assistants. It handles such highly-technical problems as the investigation of new processes developed outside the company or by the Research Section, the operation of pilot plants, design of new equipment and the testing of old.

At the same time it is on call to work with refinery service groups maintained in every plant for trouble-shooting, maintenance and other plant problems of an individual nature. However, in this latter function it has to be specifically assigned to the task by the management, acting upon the request of the individual plant superintendent, reporting its recommendations to all interested parties.

For administration Technical Service is divided into four sub-sections, each under a sub-chief: Process, Design, Laboratory, and Product Development, the functions of any one of which may be service or advisory.

On Call for Trouble-Shooting

In keeping up with technological developments or in laying out the technical data for new processes, Process Service does the necessary library research, and inspects installations at other plants; this includes conferences with process licensors and the management. From balance sheets and data which is developed, recommendations are made.

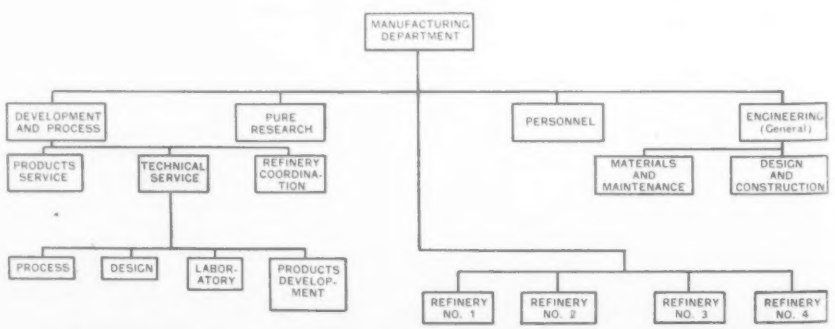


Fig. 4—Organization of Company No. 5, capacity around 90,000 b/d

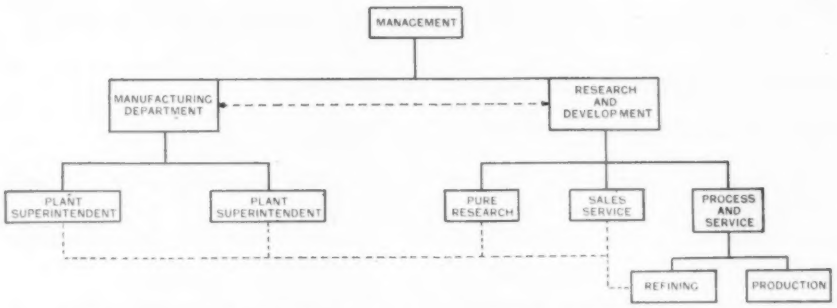


Fig. 5—Organization of Company No. 6, making specialty products. Technical Service is handled by the Process and Service section

The operation of the Technical Service group of this company involves, in addition to salary and travel expense, the purchase and maintenance of all types of laboratory equipment and the construction and operation of pilot plants. Hence its proportion of the total departmental budget is greater than for other companies reviewed here.

Company No. 6

(Midcontinent company with a small refinery in terms of crude charge, but making special as well as standard products)

An independent Oklahoma refiner delegates its technical service work on manufacturing problems to a section of its Research and Development Division known as Process and Service. The overall R & D program is directed by a manager in the home office, while the local program is directed by branch superintendent and specialized work is carried out by group leaders. This relationship is shown graphically in Fig. 5.

Personnel of the R & D division totals 14. Two of these have PhD degrees in chemistry and chemical engineering; four have BS degrees in chemical engineering, five have master's or bachelor's degrees in chemistry or other sciences; three are technicians and clerical assistants who have a minimum of a high school education. Two of the R & D group are regularly assigned to Process Service problems. When occasion demands, as many others as the problem requires are temporarily transferred to Process Service. In complex assignments, a number of the chemical engineers may be assembled in conference to review the problem and make recommendations.

Duties and Responsibilities

When Process Service believes it has a solution to a problem, a report is made to the plant superintendent and the individual who originally requested the work, with copies to all interested parties on a company-wide basis. Process Service has nothing to do with refinery operations in the sense of ordering changes. In a like manner, the operating personnel is not responsible for Process Service carrying out its duties.

The more important functions and duties of Process Service are covered in Table 1.

This company's activity in the manufacture and marketing of specialized products for industry requires changes in operation of some of its units from time to time. To produce some of the closely fractionated specialties services of stills, fractionating equipment, condensers and treating units may have to be revised. Also select charge stocks may have to be isolated. Since operating personnel is largely occupied with keeping up manufacturing schedules, Process Service with its backlog of process equipment data and stock evaluations is designated to do the technical work for these changes.

The major expenditure for Process Service is for salaries. Operating expenses are included in an annual budget. When special plant problems develop which require unforseen expenditures, the situation is taken care of by special appropriations. Approval for these appropriations requires the signature of the department head requesting the work, the plant superintendent and the managers of Manufacturing and R & D.

A budget estimate is difficult to make since the demands on Process Service vary considerably from week to week and month to month. However, with a back-log of experience for a given plant, a fairly accurate yearly estimate can be made.

Company No. 7

(Crude charging capacity around 300,000 b/d)

This large oil company operates several refineries. Its Technical Service division is entirely separate from the plant operating group and the research department. In the organizational setup it ranks with the individual operating refineries. Its director reports to the chief company executive in charge of refining operations on the same basis as the heads of the individual plants. In meetings of plant managers, the director of Technical Research has equal voice in the discussions.

Technical Service maintains headquarters at the company's largest plant and has a staff of around 60, most of whom are chemical engineers, and chemists with a few physicists. It also has one or more staff men in each refinery. The staff men in the individual plants do not, however, report to the Technical Service division manager directly. They ordinarily report to the manager of the plant in which they are located, taking in their own suggestions and advising on suggestions of others on means for improving the plant operation and efficiency.

Technical Service division representatives attend all meetings of the various groups in the company's research organization and also outside meetings of scientists and thus keep posted on what is going on outside as well as inside the company. When some new or improved process or practice is developed to the point of commercial practicality, Technical Service works out the design for the unit or process and develops data on cost of construction and operation. This is submitted to the plant management for approval and if the cost is regarded as too high, the Research Department is requested to continue or institute work to improve the design or find some other way of lowering the cost to the point of practicality.

The close co-ordination through the Technical Service division of the technical men on the one hand and the plant operating force on the other is regarded by this company as one means to offset the shortage of professional chemists, engineers and chemical engineers which exists because of the wartime drafting of students and older men into the armed forces.

TABLE 1—Functions and Duties of Process Service for a Mid-Continent Refiner

1. Trouble Shooting.
2. Supplying technical data for plant modifications to increase throughput.
3. Furnishing technical data for plant modifications to manufacture new or improved products.
4. Furnishing technical data for new process installations.
5. Assisting with operator training for new processes.
6. Keeping management posted on technological developments.
7. Furnishing data to Manufacturing on new methods of corrosion prevention.
8. Keeping abreast of modern equipment developments.
9. Making studies to reduce losses and utilize waste materials.
10. Making crude evaluations and stock break-downs.
11. Setting up blend data and blend charts.
12. Giving engineering assistance to Research.
13. Developing Research ideas into pilot plants and full scale plants.

Tomorrow . . . IN PETROLEUM TECHNOLOGY

Preview of What's Ahead . . . Based on Today's Technological and Economic Developments

Today's happenings in widely-divergent fields are destined to have vital significance in the future operations of the petroleum industry. Technical and economic topics projected this month for their possible later bearing on petroleum refining operations include:

Linkage of radioactivity to oil genesis.
Collaboration of oil and coal interests in synthetic fuels.
Petroleum companies offer varied insecticides.
Cutting oil manuals provide excellent background.
Allis-Chalmers announces marine gas turbine.
Acetylene from natural gas by electric arc processes.

Radioactivity Linked To Oil Genesis

In the present phase of the new "atomic age," it is particularly hard to judge the exact significance of each new announcement. Background information is being released in a piecemeal fashion and, usually, with evident gaps.

For this reason, it is difficult as yet to say whether or not two recent papers[1] are of more than academic interest. A news release concerning them opens with the statement that these "experiments *** hold promise of fabulous additions to the world's known oil supply through radioactivity," but the papers themselves are properly conservative and wholly technical.

Nevertheless, the fact that the bombardment of fatty acids with alpha particles and deuterons yields hydrocarbons lends a tentative measure of support to the theory that petroleum may have been (and is being) formed by the action of radioactivity on fatty residues, proteins, and other complex materials. "Research by the Geology Department at Mass. Institute of Technology has shown that there may be sufficient radioactivity in the materials of oil fields to effect this conversion over a period of ten million to one-hundred million years."

The project at M.I.T., begun three years ago under the sponsorship of the A.P.I., has also shown that cyclic hydrocarbons can be produced from such materials as naphthenic acids by radioactive bombardment, without carbon ring cleavage. If this had not been the case, the theory would have been invalidated immediately, since most crude oils contain "relatively high percentages of cyclic hydrocarbons," and any treatment which destroyed them could hardly have played a part in their slow synthesis.

"Work is now in progress to determine the manner in which complex organic substances are transformed by means of radioactivity. These reported changes in organic compound have been brought about by bombardment or radiation under laboratory conditions. Whether similar conversions may take place in the organic material present in oil fields to form appreciable quantities of petroleum is as yet unknown. The radioactivity of earth materials is now being measured, and in time, as this study progresses, some definite idea will be obtained as to the quantitative importance of radioactivity in the formation of crude oil."

According to the news release, "Identification of radioactivity as the explosive force which accomplishes this cosmic metamorphosis (!) would inaugurate a technical revoltion, enabling science to ferret out vast deposits of oil that cannot be detected by present methods." No further mention is made of this latter point.

This particular project bears little relationship to above-ground petroleum synthesis, incidentally. Few vegetable oils—much less their derivative fatty acids—sell for much below $1.00 per gallon, and, even at 10 cents per gallon (a *highly* improbable figure), the raw material cost of $4.20 per barrel would be impossibly high. In addition, radioactive treatments of any type, for some time at least, will probably be reasonably expensive treatment, even if by-products from nuclear fission are readily and cheaply available.

From any viewpoint, however, it would be foolish to underestimate the possible—probable—future effect of the use of radioactivity in petroleum operations. Research of the type mentioned here may provide the background for future refining techniques. Certain petroleum companies undoubtedly have this in mind, judging from the number of nuclear physics groups being formed in petroleum research laboratories.

Oil and Coal Interests Join In Synthetic Fuels Research

It is interesting to note that the Bureau of Mines has acted upon suggestions made as long ago as August, 1943, at hearings on S. 1243 and has named a technical industry advisory committee to serve as consultant to and receiver of information from its research program on synthetic liquid fuels.

In the words of Director Sayers, of the Bureau, "the cooperation and technical guidance of these men, all of whom are authorities on industrial petroleum and coal research, will be of invaluable assistance in attaining the objectives of the bureau's five-year synthetic liquid fuels research and development program. At the same time the information on the bureau's work will be disseminated and a liaison will be maintained with industrial concerns which ultimately may develop commercially the processes under study."

Committee members include: Eugene Ayres, staff chemist, Gulf Research & Development Co.; H. W. Field, assisant manager, research and development department, Atlantic Refining Co.; H. O. Forrest, research director, M. W. Kellogg Co. (later replaced by H. Rubin); Dr. Louis S. Kassel, research engineer, Universal Oil Products Co.; P. C. Keith, president of Hydrocarbons Research, Inc.; L. C. Kemp, Jr., director of research, The Texas Co.; E. V. Murphree, vice president in charge of research and development, Standard Oil Development Co.; and J. K. Roberts, research director, Standard Oil Co. of Indiana. Also on the committee are George Creel, research engineer, Pittsburgh Consolidated Coal Co.; Fred Denig, research director, Koppers Co.; and

(1) Sheppard, C. W. and Burton, V. L., "The Effects of Radioactivity on Fatty Acids," and Breger, I. A. and Burton, V. L., "Conversion of Cyclohexanecarboxylic Acid to Hydrocarbons by Radioactivity." Presented before Division of Organic Chemistry, American Chemical Society, Atlantic City, April 9, 1946.

Dr. Harold J. Rose, research director, Bituminous Coal Research, Inc.

Two of the companies represented on the committee have also figured in another recent news development in regard to synthetic liquid fuels.[2] According to this report, "the Pittsburgh Consolidated Coal Co. is planning to join Standard Oil Development Co. in the inauguration of a major, privately-financed research program to investigate the carbonization and complete gasification of coal." It is said that Standard will contribute its petroleum "know how" and Pittsburgh will broaden its research activities at its plant in Pennsylvania.

Standard has long been interested in the hydrogenation of coal and oils, and it seems possible that part of the investigations may be concerned with the hydrogenation of the tar produced by Pittsburgh's low-temperature coal carbonization process (the "Disco" process). High-octane gasoline was produced in this manner in both England and Germany during the recent war.

The complete gasification of coal is of great interest as the potentially-most-economic source of synthesis gas for any variation of the Synthine process based on coal. It is highly likely, therefore, that this topic was included for this purpose. Data available from German sources have indicated that several complete gasification processes reached commercial scale during war time.

Such a merger of interests as this one seems a fairly logical development. A major shortage of crude oil may not develop for many years, but, when it does—and assuming that oil demands will be high—it seems certain that coal will be the ultimate raw material for petroleum synthesis after cheaper but far-less-abundant materials (such as natural gas) become exhausted. It may be almost taken for granted that petroleum refining by then will have reached a peak of technical achievement far surpassing present levels, so that it would seem uneconomic for any coal company now planning long-term synthetic liquid fuels research to create also for itself a potential refining branch. Similarly, few petroleum companies are at present interested in going into the coal business to assure themselves of fully-integrated operations many years hence.

Cooperation instead of competition is thus indicated, and it may also be expected that the representatives of the petroleum and coal companies on the advisory committee to the Bureau of Mines synthetic fuels program will cooperate whole-heartedly to aid in the success of the Bureau's program.

Meanwhile, in present-day competition, the coal-versus-oil battle will continue—unless another interpretation can be placed on the recent doubling of the National Coal Assn.'s former levy of one mill per ton on the 340 million tons of coal which its members annually produce. In the words of *Business Week*[3] this fund will be used for research and public relations moves designed "to control the inroads of gas and petroleum competition in the domestic heating field."

Petroleum Companies Offer Varied Insecticides

The production of oil-based insecticides has long been a profitable specialty for many petroleum companies, while still others have sold considerable quantities of distillates to "chemical companies" engaged in the same manufacturing operation. The advent of DDT, however, has caused a revolution in insecticide formulations, and many newcomers "jumped the gun" by rushing on the market with DDT insecticides of concentrations which were not always safe for the probable uses.

It is of interest, then, to note the activities of one of the major producers of products of this type. According to a recent article in its house organ,[4] Gulf Oil Corp. is producing 5 DDT-containing insecticides: one for general, household (spray gun) use; one for use where "residual action" is desired; a "specific" for bedbug control; an emulsifiable solution containing 25% DDT; and a wettable powder containing 50% DDT. The last two concentrates are designed "to be mixed with water before application[11] and are intended for a variety of commercial uses.

The household insecticide contains 0.12% pyrethrins and 0.25% DDT as active ingredients. The former "are fast in paralyzing and killing action," while the DDT "does the 'mopping up';" although it is slow in action, "often requiring several hours, it is none the less fatal to a long list of household insect pests.

"The small amount of DDT in Quick-Action Gulfspray may require additional explanation, especially in view of the wide variations in the formulas of well-known competitive brands. The fact is that when it is combined with the 0.12% pyrethrins-content of Gulfspray, 0.25% of DDT is all that is required. Months of testing have shown the insect-killing power of this formula to be so amazingly high (95 to 100% against flies, for example) that for all intents and purposes the point of maximum effectiveness has been reached. To add more DDT would only reduce the desirable margin of safety which Quick-Action Gulfspray now enjoys."

Residual action insecticides, it is said, should contain at least 5% of DDT to be effective, and the one marketed by Gulf contains 6% by weight. The specific for bedbug control also contains "organic thiocyanates." Gulf also markets a non-DDT-containing insecticide spray for use where foodstuffs are processed and stored; in this, piperonyl cyclohexanone serves as a synergist to "greatly activate the toxicity of pyrethrins against insects."

Gulf is "well aware of the sales appeal" of the aerosol bomb, "principally from the standpoint of convenience, to say nothing of its novelty and general effectiveness." It reports that research is in progress "on the development of a lightweight aerosol dispenser, made possible by the availability of low-pressure gases" and that, when this dispenser is ready, "its cost will be well below that of current bombs, therefore within the budget of the 'average family.'" Apparently, Gulf does not plan to market its own aerosol insecticides until this development is achieved.

Cutting Oil Manuals Give Valuable Data

As mentioned a few months ago,[5] many industrial organizations are performing a public service while at the same time engaging in excellent prestige advertising through issuance of "authoritative booklets which describe an entire field in addition to calling attention to the product or process in question. Such bulletins are a valuable part of any file, since they often contain information not available elsewhere in a useable form."

Two such booklets [6, 7] on cutting oils have recently come to the writer's attention, and the failure here to mention similar issues of other companies in this field may be attributed solely to lack of their possession.

The first booklet[6] provides an excellent description of cutting fluids and operations; functions, types, and handling of cutting oils; dermatitis from cutting oils and its prevention;

(2) Anon., *Chemical Industries* 58, No. 4, 651 (1946), "Private Concerns to Evaluate Synthetic Fuels Processes."

(3) Anon., *Business Week*, No. 866, 87 (1946), "Coal Will Fight Back."

(4) Anon., *The Orange Disc* 7, No. 6, 2 (1946), "New Weapons for the War on Insects."

(5) Anon., NATIONAL PETROLEUM NEWS, *Technical Section*, 38, No. 14, R-248 (1946), "Tomorrow in Petroleum Technology—Hydrogen Processes Discussed in Booklet."

(6) *Lubricants and Coolants for Cutting and Grinding*, The Texas Co., New York, 1945.

(7) *Gulf Cutting Oils For Increased Production and Longer Tool Life*, The Gulf Oil Corp., Pittsburgh, 1945.

a list of Texaco cutting and soluble oils; and several technical charts for use in cutting operations on different metals.

In contrast, the second booklet[7] devotes only ten pages to a description of the types and functions of cutting fluids and then uses the remaining 46 for a "Machinery Guide" which contains much "useful data on machine shop practice."

According to the latter, "the proper application of the right cutting oil; (1) makes possible higher cutting speeds, (2) helps maintain accuracy, (3) improves the quality of the finish, (4) increases tool life, (5) reduces machine time lost for tool changes, (6) minimizes rejects attributable to tolerance or finish, and (7) lowers power consumption."

The Texaco booklet states that cutting oils have "two primary functions, viz.: to dissipate heat and to lubricate. Contingent upon these, the cutting fluid must: (1) enable the cutting tool or grinding wheel to produce a satisfactory finish, (2) prolong the life of cutting tools, (3) prevent rust and corrosion, and (4) carry and flush away turning chips and grinding dirt. . . .

"The cutting fluids most extensively used today can be grouped under the following general headings: straight mineral oils, mineral lard oils, sulfurized mineral lard oils (dark and transparent types), sulfurized mineral oils (dark and transparent types), and soluble oils."[6] Choice of the proper oil depends upon such factors as "(1) character of material to be cut, (2) cutting speed, (3) proper tool setting, etc."[7]

It is obviously impossible to reproduce here all of the technical data contained in these books, which typify the trend to inter-company competition on the high level of consumer service.

Allis-Chalmers Announces Marine Gas Turbine

As mentioned, competition is the spice of industrial life. It is, therefore, of interest to note[8] that the Allis-Chalmers Mfg. Co. has presented the Elliot Co.[9] with a competitor in the form of a 3500-h.p. multistage gas turbine, designed and built in connection with the Navy's research program at Annapolis but kept secret for the past two years.

This turbine has been operated successfully at a gas temperature of 1350° F., but was designed for and will eventually be operated at 1500° F., at which temperature "an over-all thermal efficiency of 40% could be obtained in marine applications, compared with about 25% efficiency for an average steam turbine plant and something over 30% for diesel power." Allis-Chalmers has already built 30 gas turbines for lower temperature (1000° F.) use in petroleum refineries.

Westinghouse is also active in the gas turbine field, and, in Switzerland, Brown-Boveri is a pioneer. According to *Business Week*,[8] "one of the American manufacturers will build a 4500 h.p. oil-fired gas turbine to power a locomotive, and promising progress has been made in the experimental development of a coal-fired unit for locomotives.

"If the coal-fired gas turbine were to become a practical reality, it could beat the steam turbine and the diesel engine by a clear margin when it comes to developing low-cost power. But until that happens—and it may not happen soon—many engineers refuse to get too excited about the gas turbine's future as a prime mover in power-generating plants."

Acetylene From Gas By Electric Arc Process

The petroleum industry continues to view with interest the various processes for the conversion of natural gas to acetylene. Two such methods have been widely publicized in recent years, one based on regenerative high-temperature cracking and the other on the use of the electric arc. Technical descriptions of both have recently appeared in NATIONAL PETROLEUM NEWS[10], [11], and comment on the former has been made in an early issue of this series.[12]

It seems highly likely that one or both of the processes will be in large-scale use in the near future. Last year, for example, Petroleum Chemicals, Inc., was reported to be ready to begin "mass production" of acetylene from petroleum as soon as conditions would permit, and previous information[12] adds to the authenticity of this item on use of the Wulff (regenerative) process.

Similarly, it is possible that the electric arc process, commercially employed in Germany,[11] will soon be used in this country. Shortly before the end of the war, the board of regents of the University of Texas granted permission to the Chinese Government to use the "Schoch process" royalty-free for the duration of the war, after which it was to pay the university the same royalty as any U. S. company who might then be using the process and to "give the university patent rights," presumably to any new developments.

The Chinese were said to be planning to use the acetylene so produced as a raw material for alcohol for internal combustion engine fuels. Whether the subsequent end of hostilities altered these plans has not been revealed, but it is interesting to note that Schoch stated, at the time, that the Commercial Solvents Corp. had erected a pilot plant at Terre Haute, Ind., to test his process.

However, the Corpus Christi Oxygen Co., which had been planning to use natural gas as the raw material for acetylene in its new acetylene plant at Corpus Christi, Texas has announced that it has decided instead to use the more common calcium carbide process, because the natural gas process is "not far enough along yet." While it was not clear which type of process had been considered, it seems likely from the location of the company that the electric arc process was the one in question.

Despite the details of German operations now becoming available,[11] it is too early to state that the electric arc process will definitely be employed here on a large scale. To begin with, German economics were far different from those existing in this country. Secondly, cheap electric energy is not abundantly available here, although, as Schoch pointed out early in the war (when his process was considered as a possible method for butadiene manufacture), the use of off-peak energy might negate this factor to a large extent.

Also, the process has not yet been completely evaluated; S. D. Kirkpatrick has reported,[13] for example, that he was told by the German engineer in charge of the Huls plant that "the carbon black obtained as a by-product is not as satisfactory for buna rubber as that made from naphthalene and anthracene." How it compares with the carbon blacks prepared from natural gas by the usual (American) methods was not stated.

Finally, there is at present no method of comparing German data with that for the Schoch process, since no technical information on the latter has apparently been released.

(8) Anon., *Business Week*, No. 867, 54 (1946), "Gas Turbine Evolution Speeded"; Custer, J. R., *Automotive and Aviation Industries* 94, No. 8, 28 (1946), "Allis-Chalmers 3,500 h.p. Gas Turbine Undergoes High Temperature Tests."

(9) Anon., NATIONAL PETROLEUM NEWS, *Technical Section*, 37, No. 36, R-744 (1945), "Keeping Up With the News—Marine Gas Turbines."

(10) Anon., NATIONAL PETROLEUM NEWS, *Technical Section*, 34, No. 34, R-271 (1942), "Acetylene and Other War Chemicals Made By Cracking in a Regenerative Furnace."

(11) Anon., NATIONAL PETROLEUM NEWS, *Technical Section*, 37, No. 45, R-865 (1945), "Arc Cracking of Gases Yields Acetylene for Butadiene in Huls Rubber Plant."

(12) Anon., NATIONAL PETROLEUM NEWS, *Technical Section*, 36, No. 31, R-566 (1944), "Keeping Up With the News—The Wulff Process."

(13) Kirkpatrick, S. D., *Chemical & Metallurgical Engineering* 52, No. 6, 94 (1945), "Through Germany in a Jeep."

Increase Output of Alkylate Over 600% By Removing Equipment Bottlenecks

By G. B. Ryan and D. G. Stevens
Manufacturing Department, Standard Oil Co. (Ohio)

Use selected feed stock and eliminate equipment bottlenecks!

That was the formula applied by one refinery to its H_2SO_4 alkylation plant, designed for an output of only 225 b/d, to increase production to nearly 1600 b/d.

Built for peacetime operation before Pearl Harbor, the plant was designed to run on excess refinery butanes, high in normal butane and olefins but low in iso-butane. When war struck, the refinery engineers shopped around and found an additional source of feed stock from another company, which produced an excess of the short iso-butane. That move more than doubled the output.

Next the engineers surveyed the equipment. They found that the existing reactor, de-isobutanizer, debutanizer and alkylate rerun towers could be operated efficiently at loads far in excess of their designed capacities with only minor changes in existing equipment.

These changes and how they were applied are described below in this exclusive NPN TECHNICAL SECTION feature, written by two of the engineers on the project.

AS A result of wartime experience, Standard Oil Co. (Ohio) learned how to boost the output of its Toledo Alkylation unit over 600%—and on a basis that can be economical for peacetime operation.

The story of this greatly increased production rate of high-quality alkylate is largely one of taking up slack in plant capacity by eliminating equipment and process bottlenecks.

Sohio's plant, of the sulfuric acid type, was not originally intended for wartime operation. It was placed on stream on Dec. 6, 1941, the day before the Jap attack on Pearl Harbor. The preliminary studies which justified the installation of the plant were, of course, completed far prior to that date.

The plant was actually designed to supply a moderate peacetime demand for high octane aviation fuel for commercial use in the Ohio area. Excess refinery butanes, effluent from an existing catalytic polymerization unit, were to be converted into what shortly was to seem an almost negligible quantity of aviation alkylate.

Scarcely had the foundations been poured, however, when it became increasingly apparent that high octane ingredients such as alkylate were going to be required in quantities unheard of in normal times. Thus, even before the plant was completed, plans were being made for increasing its output. The result was that during its initial week of operation production was almost double the design capacity of 225 b/d.

For almost two years after the alkylation plant was put into operation, methods of increasing its production capacity were top priority projects on the work schedules of Sohio's technical staff and operating personnel. The ultimate reward for these efforts was received in 1944, during which year the alkylation plant achieved an average calendar day production rate more than 6 times that for which it was initially designed. Table 1 shows the rate at which progress was made in increasing alyklate production. Even better results were achieved up to the cessation of hositilities in 1945.

The program for attaining this greatly increased production was laid out by Sohio technologists in the fall of 1941. This program entailed two phases, both of which were of primary importance. These two phases were:

1—Careful control and selection of feed stocks.

2—Removal of mechanical bottlenecks.

The more detailed discussion of these two phases will be taken up in the order listed above, since that is the order in which they began to take effect on the plant operation.

Before describing the details of how plant capacity was increased, however, it might be well to explain that the reactor system in this alkylation plant is somewhat unique. The reactor itself is

Capacity of the alkylate rerun tower (to the left) was doubled by preheating the feed and running it into a preflash drum (located on the platform in the foreground) before charging it to the tower. In this manner about 50% of the feed was preflashed directly to the overhead condensers without going through the tower

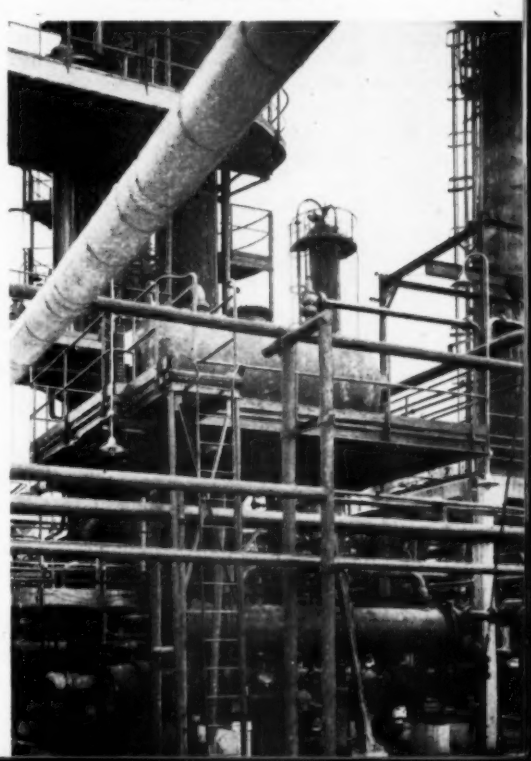


TABLE 1—Toledo Alkylate Production Rate and Pertinent Operating Data

Date	Apr., '43	June, '43	Dec., '43	July, '44	Oct., '44
Avg. Alky. Prod'n. (BPCD)	412	681	960	1295	1591
Octane Ratings					
1c + 4.00cc-TEL (Iso +)	0.94	0.86	0.74	0.62	0.60
3c + 4.00cc-TEL (s +)	8.80	3.37	3.28	2.54	2.81
External i-C$_4$ olefin Ratio	14.5	10.9	10.4	14.0	11.8
Acid Strength, Wt.-% H_2SO_4	92.9	93.6	93.6	91.5	91.9
Lt. Alky. End Point, °F.	326	339	362	358	356
Reactor Temp., °F.	43	41	41	41	41

TABLE 2—Change in Composition of Fresh Feed to Sohio's Alkylate Unit Over a Three-Year Period

Liquid Vol.-%	Dec., '41*	Feb., '42	Apr., '43	Sept., '44
C_3	2.0	2.2	2.9	3.0
i-C_4	13.3	22.8	29.8	43.6
C_4 =	17.2	19.1	26.7	32.2
n-C_4	67.0	54.7	37.8	20.6
C_5	0.5	1.2	2.8	0.6
Total	100.0	100.0	100.0	100.0

*The original feed stock available at Sohio's own Toledo refinery, the effluent from an existing poly plant.

divided in to four compartments with the baffling so arranged that the hydrocarbon-acid emulsion will flow from one end of the reactor to the other. The first three compartments are equipped with propeller-type mixers that act as both a mixer and an internal emulsion recirculating pump. The fourth compartment is a primary acid hydrocarbon settler.

The reactor is operated with a liquid level at such a height that there is a small vapor space, approximately 20% of the volume of the drum, above the liquid. Vapors are withdrawn from the top of the reactor through an appropriate knockout system and then compressed and condensed with the major portion of the condensed liquid returning to the reactor. Removal of vapor from the reactor is regulated so as to control the reactor temperature at the desired level.

This auto-refrigeration system, besides maintaining reactor temperature, gives a propane-rich liquid to the compressor condensate for feed to a depropanizer tower in order that the propane content of the reactor system can be controlled. The compressor condensate is the highest propane content stream in the entire alkylation plant and allows minimum sized equipment for maintaining the propane content of the system.

Feed Stock Selection and Control

As mentioned above, it had originally been planned to operate the plant on the butane effluent stream from an existing C_3-C_4 catalytic polymerization plant. This stream, while containing the requisite quantities of butylenes and isobutane for the design alkylate production, was far from being a perfect alkylation feed stock. It was expected to contain as much as 70% of normal butane diluent as shown in the first column (Dec. 1941) of Table 2.

Moreover, it was anticipated that this feed stock, being butane derived solely from thermal operations, would normally contain an excess of butylenes over and above the quantities required for theoretical reaction with the isobutane present. In the design of Sohio's plant, this problem was to be solved by charging the alkylation feed stream to the plant's isobutane tower, rather than direct to the reactor, as in conventional operation. Operating in this manner, it was expected that the requisite external ratio of isobutane to olefin could be maintained by regulating the quantity of olefin taken overhead in the isobutane tower, discarding excess butylenes in the tower bottoms stream.

Although this method of operation works well on paper, it was apparent to any engineer familiar with alkylation operation that the operating problems would be numerous and troublesome, resulting in difficulties in control which would undoubtedly result in a production rate on a calendar day basis considerably less than that shown to be possible by the calculations.

It was also apparent that if the feed could be enriched by the addition of isobutane, making it possible to feed directly to the reactor in the conventional manner, an immediate increase in production could be realized.

Several complete testing programs and analytical studies had made it apparent that no additional alkylation feed of the type desired was to be obtained within the confines of the Toledo refinery. Any possible assistance would have to come from outside. The company's other three refineries were studied, but since the butane streams available there were all nearly identical to the one available at Toledo, it was apparent that no help would be forthcoming from that quarter.

Accordingly, the problem, together with all the data indicating the relative quantities involved, was submitted to the Sohio home office operating staff, and inquiries were sent out to nearby companies who represented possible sources of the requisite quantities of isobutane. It should be borne in mind that this search was undertaken before the plant commenced operation, before the start of the war, before PAW and the Aviation Gasoline Advisory Committee light hydrocarbon supply and requirements program had materialized, and long before the petroleum industry was well acquainted with the importance of isobutane as a war-critical product.

First, the various natural gas and natural gasoline producers in Ohio and surrounding states, normal suppliers of butane to the refining and bottled gas industries, were contacted. Although a small amount of additional isobutane was obtained from these sources, the quantities involved were generally too small, and the concentration of isobutane in the BB stream was too low to provide a permanent solution to the problem.

Then, shortly before the scheduled starting date of the unit, a butane purchase and exchange agreement with another company operating a catalytic cracking unit in Toledo was worked out. The stream obtained by this agreement normally contained an excess of isobutane, making it possible, by careful control of outside butane receipts, to enrich the original Sohio stream to a point where it could be fed directly to the alkylation reactor, obtaining complete utilization of all available olefins without sacrificing the desirable high external ratio of isobutane to butylene.

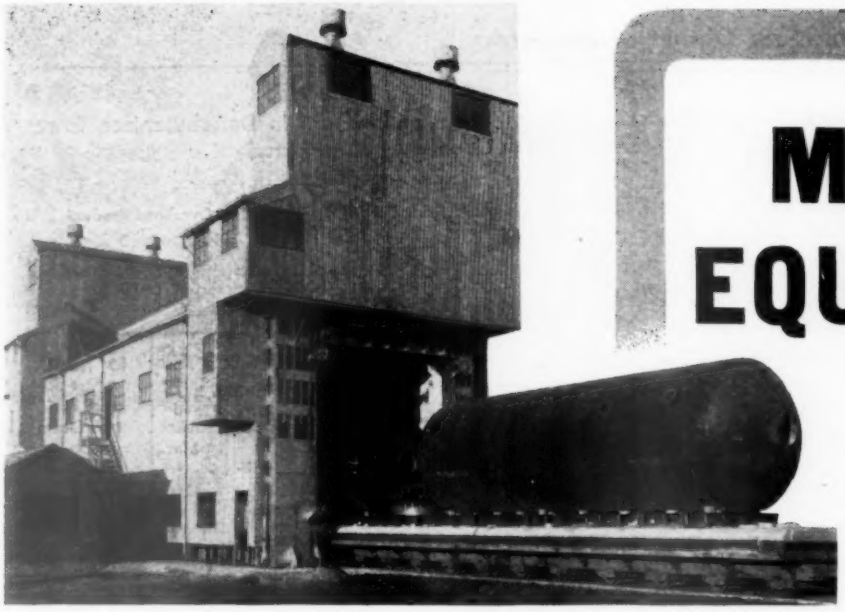
Obtaining this outside source of alkylation feed gave the plant its first big boost in production. As time went on, additional sources of feed stock were located until finally it was possible to keep the plant running continuously at maximum output as dictated by the mechanical limitations in the alkylation plant proper. Table 2 shows the effect of this feed-enrichment program on the composition of fresh feed to the unit over the three year period prior to September, 1944.

At times during the operation of the plant, feed stocks of varying composition were obtained from as many as 6 outside suppliers. Since the entire butane storage facilities at Toledo consisted of one 30,000 bbl. Hortonspheroid, constant attention to butane shipments and receipts and close co-operation from outside suppliers was required in order to maintain a steady source of good quality alkylation feed. How well these requirements were met is best demonstrated by the fact that during 1944 the alkylation plant had an operating service factor considerably greater than any other unit in any Sohio refinery.

Bottleneck Removal

As outlined above, the initial phase of the expansion program was almost entirely concerned with the selection of proper feed stocks. Arrangements for the principal butane exchange agreement had been completed prior to the start-up date of the plant.

By the time the unit was ready to commence operation, sufficient butane feed of suitable quality was available to allow a daily production well over the design rate. By the end of the first week's operation, it had reached a production rate more than twice that for which it had been designed. With the feed stock augmented and improved by outside butane receipts, it was possible, by accumulating feed in the available storage tank, to run a series of tests on the plant to determine where the limitations were. These tests showed that the deisobutanizer, debutanizer, and alkylate re-run towers would be capable of operating efficiently under liquid and vapor loads far greater than those for which they had been initially designed, provided that operating conditions were set at the



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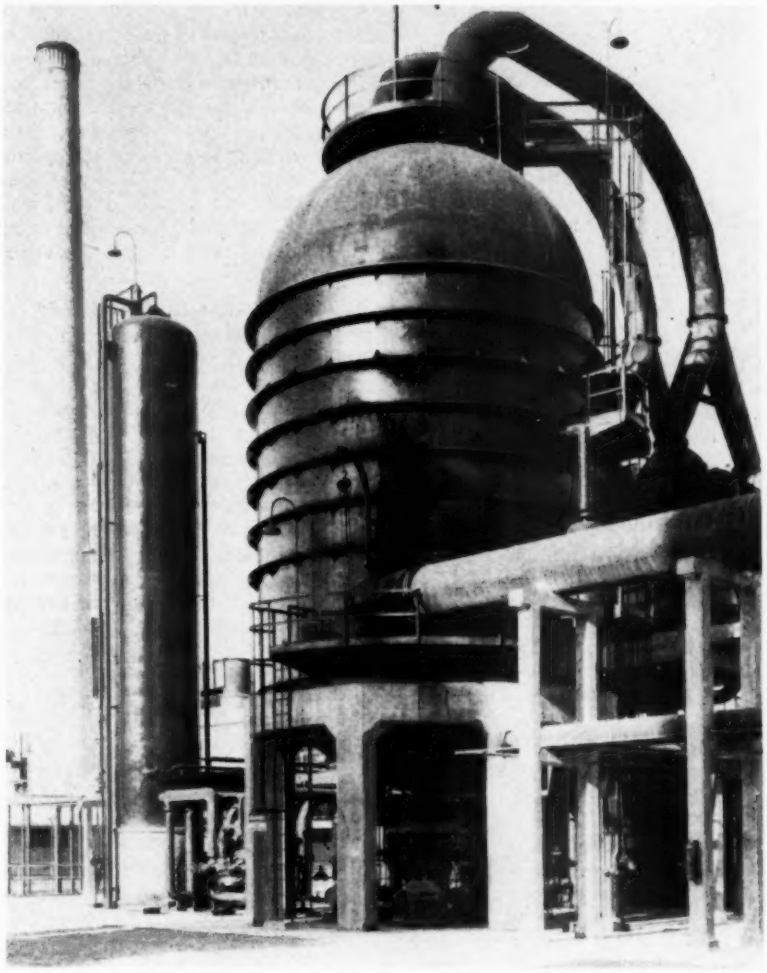
● *The view at the right was taken at the Avon, California refinery, of the Tide Water Associated Oil Company. It shows a vacuum distillation unit which forms part of the facilities that prepare stock for the cracker.*



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optimum and certain minor changes were made to auxiliary equipment. The changes recommended for each of these towers are discussed below:

1. Deisobutanizer: Calculations based on test information indicated that there was one optimum tower pressure for maximum overhead vapor load. The instrumentation, as originally designed, provided for control of the pressure by the flooded condenser type of operation. This method involved varying overhead product rates to maintain the desired pressure, while the tower bottom temperature was held constant by varying the quantity of steam to the reboiler. In order to obtain the optimum pressure at the desired overhead product rate, the instrumentation was rearranged, as shown in Fig. 1, so that the overhead product rate was set at a maximum and the tower pressure was controlled by varying the steam to the reboiler. This system allowed the regulation of product quality at the top of the tower rather than at the bottom.

In order to operate the tower in this manner, higher reboiler temperatures and greater reboiler capacity was required, necessitating the substitution of live steam (150 lb.) for the exhaust steam (15 lb.) contemplated in the plant design. It was also necessary to add one additional pump to handle the increased quantity of overhead product.

These relatively minor changes permitted operation of the tower at overhead product rates approximately 100% greater than those for which it had been designed without sacrificing quality. This increase, coupled with the improvements in fresh feed quality effected by the feed stock selection program outlined previously, permitted obtaining external isobutane olefin ratios substantially the same as those contemplated in the plant design, while operating at greatly increased alkylate production rates. Table 3 gives representative test data on this study.

2. Alkylate Debutanizer: A series of tests had shown that this tower could be operated satisfactorily at extremely low reflux rates, in the neighborhood of 0.5 to 1.0. At these low reflux rates, a further increase in overhead product rate was obtained, without sacrificing bottoms product quality, by increasing the operating pressure. To effect this increase in pressure at the maximum overhead product rate, it was necessary to substitute hot gas oil, obtained from an adjacent plant, for live steam in the reboiler. Since improvement of feed stock quality had already decreased the load on this tower per barrel of alkylate produced, these few changes were all that were necessary to fit this equipment into the expanded alkylate production program.

3. Alkylate re-run tower: A potential bottleneck was removed in the operation of this tower by making use of information received through the Alkylation Subcommittee of the Aviation Gasoline Advisory Committee. The capacity of the tower was doubled by an expedient which now appears relatively simple. By installing a pre-heater, approximately half of the feed to the tower was preflashed directly to the overhead condensers. Since more than 90% of the feed to this tower would ordinarily be taken overhead, it is possible, by this method, to accomplish a good part of the desired separation in this relatively crude, improvised,

TABLE 3—Test Results in Study of Optimum Pressure in Deisobutanizer Tower for Maximum Overhead Vapor Load

(50 Tray Isobutane Tower Capacity vs Pressure)

Pressure, psig	Min. Reflux Ratio	Min. Theo. Trays	Net Overhead Product, b/d
60	2.35	17.6	3490
80	2.42	18.2	3665
100	2.57	19.3	3725
120	2.82	21.2	3615
140	3.20	23.6	3425

TABLE 4—Effect on Product Quality of Preflashing 50% of Alkylate Re-run Tower Feed Directly to Overhead Condensers

	Before Preflash Drum			After Preflash Drum		
	Dec., '44	Jan., '44	Avg.	Mar., '45	Apr., '45	Avg.
Avg. Alky Prod., b/sd	1273	1347	1292	1628	1265	1446
% Heavy Alkylate	15	17	16	10	8	9
Octane Number						
1c+4.00cc. TEL	.66	.66	.66	.67	.62	.64
3c+4.00cc. TEL	....	1.81	1.81	2.89	3.00	2.94
External Ratio, i-C_4/olefin	14.6	15.1	14.8	7.0	12.2	9.6
Acid Strength, Wt.-% H_2SO_4	91.2	91.5	91.4	91.3	91.4	91.4
Acid Consumption, lbs./Gal. Alky	1.15	1.53	1.34	1.04	1.28	1.16
End Point, °F.	378	359	368	330	315	322
Reactor Temp. °F.	44	42	43	35	32	34
Pressure, psig	8.8	8.8	8.8	6.9	4.5	5.7

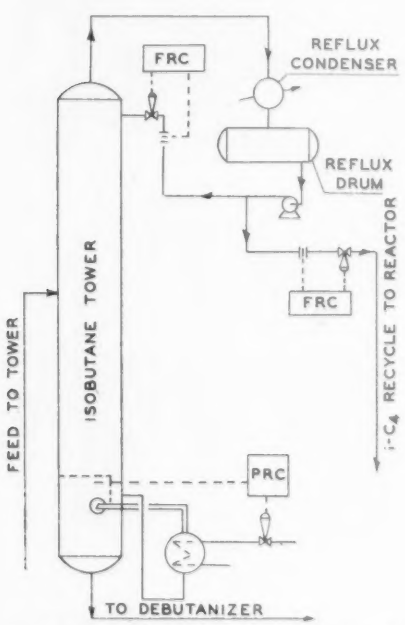


Fig. 1—Instrumentation diagram for the isobutane tower, as rearranged to allow for regulating the quality of product at the top of the tower instead of at the bottom. (FRC—flow recorder-controller; PRC—pressure recorder-controller)

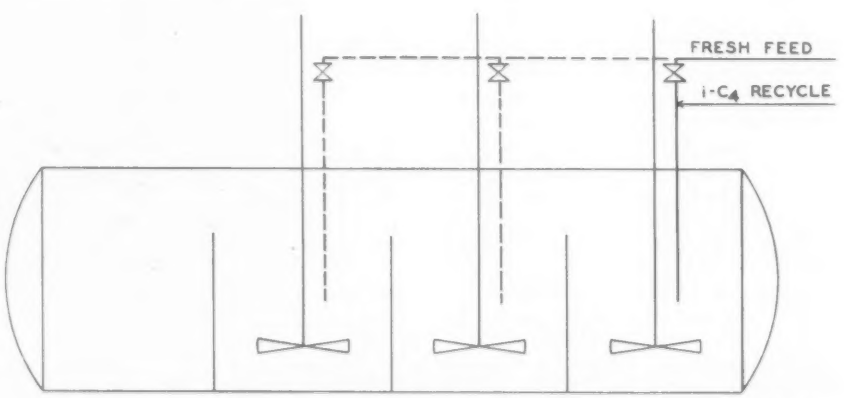


Fig. 2—Diagrammatic sketch showing how the feed system was changed in Sohio's alkylation reactor to give multiple-point olefin injection. As originally designed, fresh and recycle feed stocks were both charged into the first compartment only (solid line). As redesigned (broken line), the isobutane recycle was still charged into the first compartment but the fresh olefin feed stock was charged into all three compartments at the same time

fractionating equipment, thus eliminating this bottleneck. The distillation and general quality characteristics of the light alkylate, as shown in Table 4, were not affected by this system, and a decrease in the loss of aviation component to alkylate bottoms was accomplished.

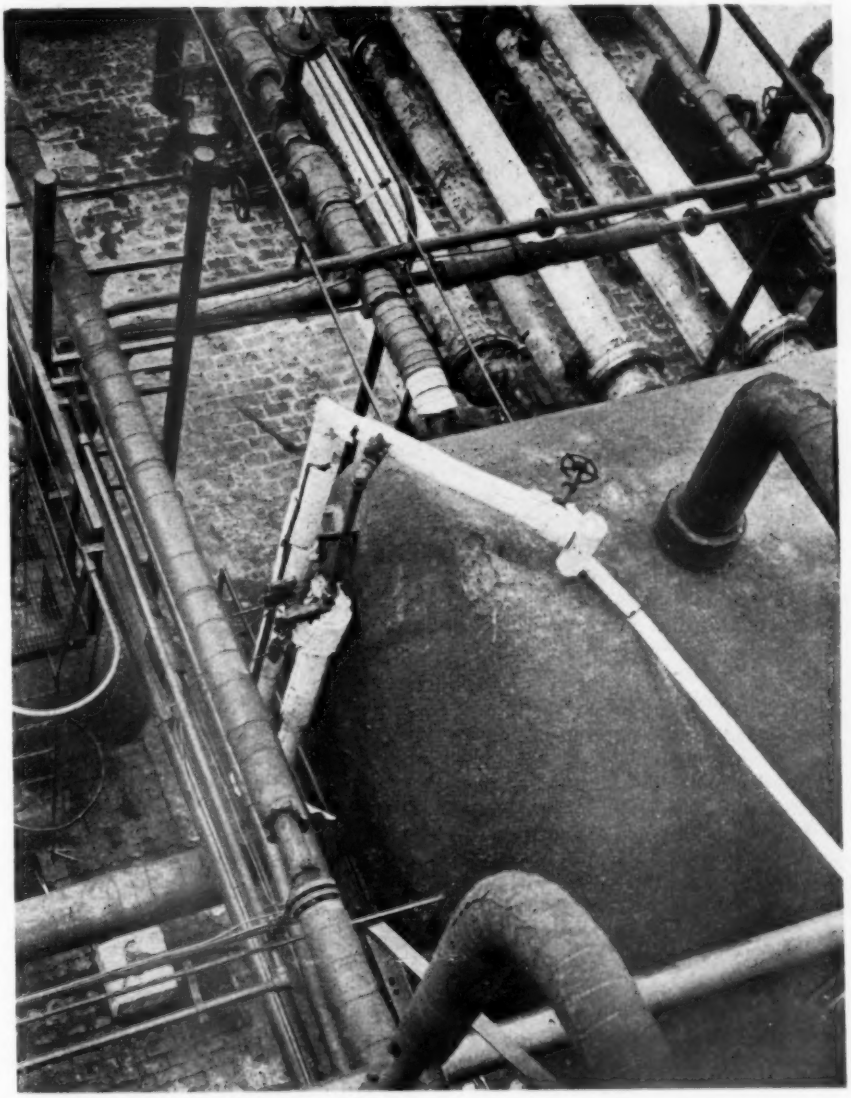
4. General: The initial testing program showed no limitations in the capacity of the reaction system of the plant. Mixing, residence time, and emulsion recirculation facilities all appeared to be more than adequate for the increased throughput rates for which conditions could be forecast from the test data. Therefore, it was decided that no changes to this part of the plant were necessary.

Shortly after the completion of the test program, however, data became available through the Technical Advisory Committee which showed the advantages of what is now known as "multipoint olefin injection". This system is applicable to any alkylation plant having a series of reactors, or one reactor consisting of several sections, as was the case with the Toledo plant. This method of operation involves putting the fresh feed, which is the olefin-rich stream, through the reactor sections in parallel, while the isobutane recycle stream goes through the same sections in series. Obviously, a much higher ratio of isobutane to olefin is obtainable in this manner, resulting in a more efficient reaction and a higher quality product at increased production rates. Converting the reactor to multipoint olefin injection was merely a matter of rearrangement of the piping, as illustrated in Fig. 2, and the changes were made at the same time as the changes to the towers outlined above.

From the available test data, it was apparent that additional residence time would have to be provided in the acid settler, in order to completely break the emulsion and guarantee that no acid would be carried over into the hydrocarbon phase. Accordingly, a 10 ft. by 30 ft. drum, salvaged from an old Burton cracking still, was connected to the overflow line from the original acid settler, this in effect increasing its size without the necessity of moving it or interfering with the operation of the plant except for a short shutdown to allow tying-in the necessary lines. A new circulating pump having a sufficient capacity to handle the increased acid rates inherent in the greater plant production ratio was manifolded into the original settler and the auxiliary drum.

Economics and Postwar Operation

As for the economics of these greatly stepped-up operations, experience during the past four years has shown that the cost per barrel of alkylate produced has been decreased considerably.



In the foreground is one end of the 10 by 30 ft. acid settler, salvaged from an old Burton cracking still. The reactor effluent-reactor feed exchangers are in the upper right hand corner

Actual operating expenses were lower, because no additional personnel were required to run the plant at its high rate of throughput and production than would have been required to run it at its design capacity of 225 b/d. Acid consumption increased, but only in proportion to the output, consumption per barrel of alkylate remaining fairly even. Feed stock costs were higher because of outside purchases of selected material, but not sufficiently higher to eat up the labor savings.

Maintenance and repairs have not been any more extensive than would have been expected at normal operation. The increased load doesn't appear to have put any undue strain on the equipment, with the result that the depreciation charges each year will remain about the same, except that they can be spread more thinly over the greater alkylate output.

Today the Toledo alkylation unit is operating at about 500 b/d, still more than 200% over its design figure. The reasons for this drop from the wartime peak of over 1600 b/d are twofold:

First, the demand for super aviation fuel has lessened considerably, with the resulting decrease in the alkylate requirements.

Second, it isn't considered economical to use alkylate for blending with motor fuel in competition with poly gasoline. Outside purchases of feed stock would still be required to obtain high yields of alkylate, and it is less expensive to use plant feed stock for making polymer.

If a feed stock high in iso-butanes should become available in the Toledo refinery or if the demand for high-quality alkylate should increase considerably, then Sohio is ready with the know-how and experience to push its alkylate producton to the wartime peak of over 600% capacity.

PLANT PRACTICES

. . . for refinery Superintendents and Foremen

Practical Tips and Ideas Based on Actual Refinery Operating Experience

Develop New Spring-Loaded Pipe Scraper For Removing Wax in Lube Oil Plant

By T. E. SCHLEY—Asst. Refinery Supt., Magnolia Petroleum Co., Beaumont

In the solvent dewaxing process employed in the production of lubricating oils at the Beaumont Refinery of Magnolia Petroleum Co.'s double pipe exchangers are used to chill the wax-oil-solvent mixture to filtering temperature.

To maintain the desired heat transfer rate, wax must be continuously removed from the wall of the pipe. This function is performed by scrapers rotated on shafts, but the design and type of scrapers has posed a major mechanical problem.

The double pipe exchanger scrapers originally were equipped with solid ribbons in the shape of a spiral attached by welding to lugs, Fig. 1. This type of scraper was deemed unsuitable because after the ribbons had worn a small amount the heat transfer was reduced due to the thin wax film left on the pipe wall.

The ribbon scraper was replaced with a "U" spring scraper with springs of light metal and curved blades, Fig. 2. Excessive breakage outlawed this scraper and heavier springs were used in the third trial, but breakage remained high. In the fourth trial, heavy "U" type springs and straight blades "in line" with shaft were used. In comparison with previous trials this installation was considered good, but with 25 broken springs per shaft in 90 days operation, other means for removing the wax film from the inner pipe were needed.

Fig. 3 shows a new type of spring-loaded scraper, developed by the writer, which is proving superior to other mechanical installations for this purpose. This new scraper has substantially reduced maintenance costs and increased the unit's production

Salient features of this device are: (1) spring holders are tack welded to the shaft on quarters, (2) rocker arms are off-center 11/16-in. to shaft which allows the scraper blade to leave the inner pipe surface in minimum time for clearing such obstructions as occasional ice formations, (3) small springs are used, (4) and, by not carrying blade on spring, even though a spring breaks the blade will not be damaged. This scraper is being produced by Fritz W. Glitsch and Sons, Dallas.

The major difficulty involved in the spring loaded scraper installation is pressure drop. This drop was 2.7 times that of the conventional "U" type scraper in the original installation, but with a decrease in breakage of over 60% and with information now available which will allow less springs per foot of scraper, the new spring-loaded design should result in an 80-90% increase in efficiency of the exchange equipment.

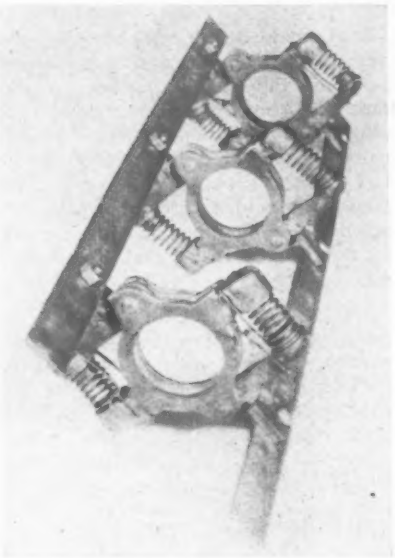


Fig. 3—Present type of spring-loaded scraper, which should increase chiller heat-exchanger efficiency 80-90%. Breakage is over 60% less than with earlier designs. Spring holders are tack-welded to the shaft

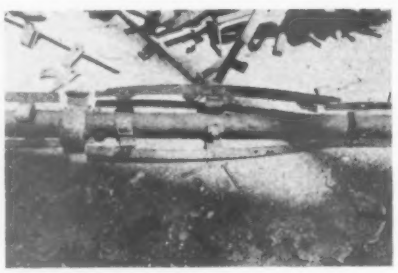


Fig. 2—First design of scraper tried by Magnolia after discarding the type shown in Fig. 1. Excessive spring breakage outlawed this scraper, despite substitution of heavier springs

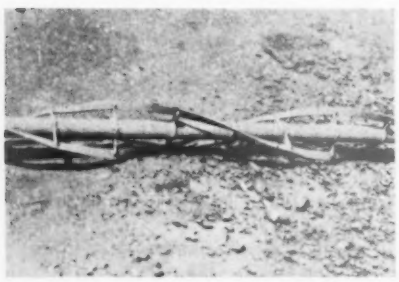


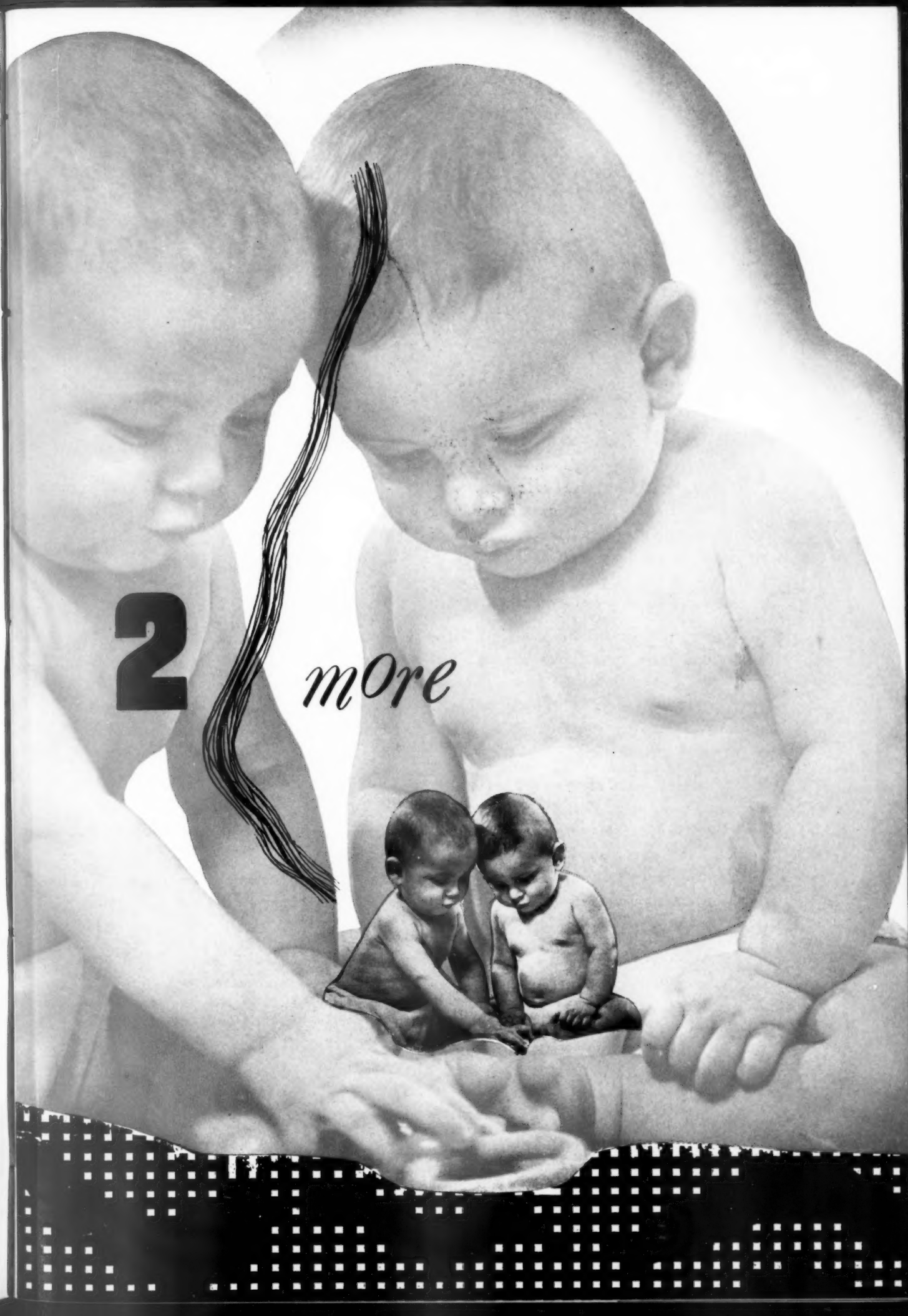
Fig. 1—Original scraper, with solid ribbons attached by welding, was considered unsuitable because it left a thin film of wax as the result of wearing of the blade

Utilize Waste Space in Fabricating Shop By Locating Welding Generators Overhead

The maintenance department at Cities Service Refining Corp.'s Lake Charles refinery recently solved the problem of getting its 20 welding machines out of the way, minimizing noise and gaining valuable floor space at the same time, by locating generators overhead in the fabricating shop.

When the building first was occupied, the 20 generators were placed ten to a side between the structural columns lining the central aisle of the shop, welding being done in the bays to either side of the aisle. This made it necessary to swing large pieces of work over the top of the welding generators on monorail cranes or first move the generators out of the way, with the ever-present danger of dropping or banging something into them. Twenty machines running at once also created much objectionable noise, while cables frequently were in the way or liable to damage when strung out on the floor.

The problem was solved by building railed platforms about 4 ft. by 50 ft.,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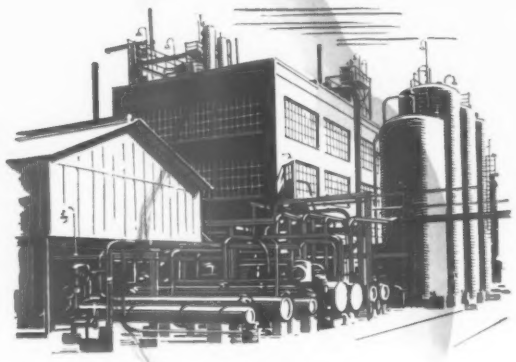

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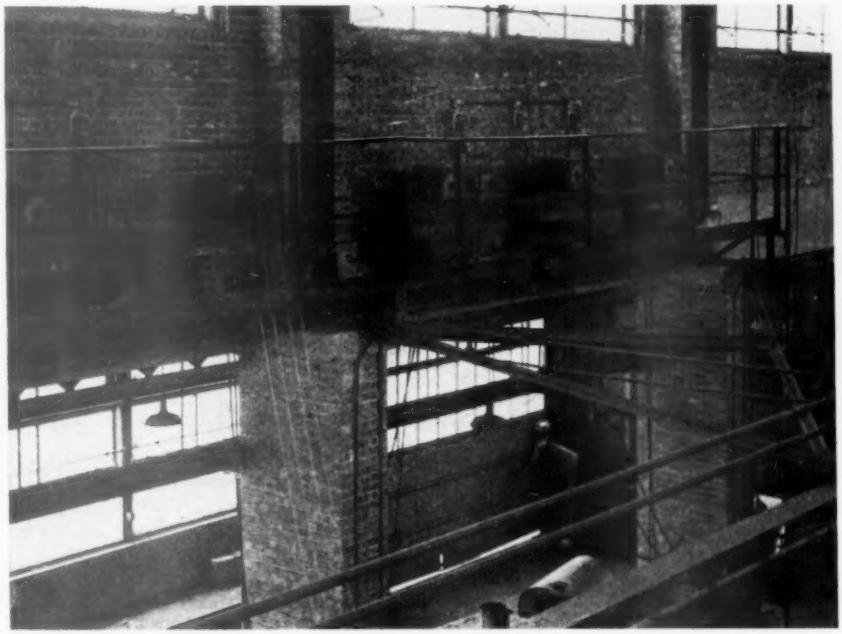

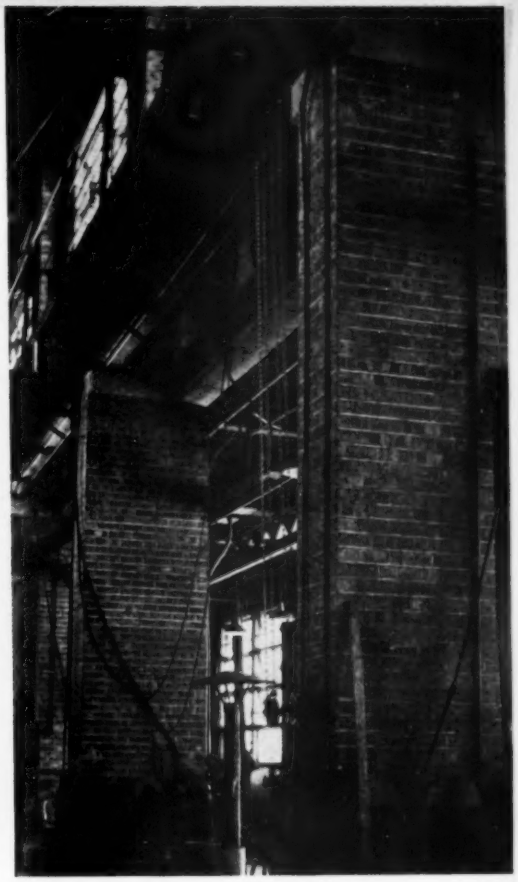

ABOVE—View of one overhead platform on which ten welding generators are mounted to gain valuable floor space. Note that generator at left center has been equipped for remote control from the floor, eliminating the necessity of climbing up to the platform to make adjustments. All generators will be equipped in this manner shortly

RIGHT—Close-up of remote control for platform-mounted welding generators. Overhead is the platform, with details of supports visible

along each side of the aisle and located 15 ft. 10 in. off the floor. Ladders were provided for easy access from the floor. Machines were hoisted into place and, with the overhead skylights open, both noise and heat were sharply reduced. Size of the platform gives sufficient room for adjustment and routine maintenance. Only in the case of a major overhaul or required use in the field is it ever necessary to move a generator.

At present it still is necessary to climb the ladder to make adjustments in voltage or amperage, but remote control equipment at floor-level will be installed as soon as time permits. The cables hang down from the platform, thus getting all cable out of the way except that actually needed for the work. Cable is piled on the platform rather than reeled. Experience has taught that coiling cable predisposes to early insulation failure from the heat induced from coil-effect when reeled.

Space formerly occupied by the machines now is available as work space and danger of something falling on the machines is entirely eliminated. As soon as remote-control equipment is installed at ground-level the last remaining hazard will be minimized: that of a man falling from ladder or platform while making adjustments, plus lost time resulting from ascent and descent.

Tip of Centrifuge Tube Save Hydrocarbon Samples

Pure liquid hydrocarbons for calibration of infra red spectrometers usually are supplied in small test-tubes or ampoules; transferred to the sample cell of the instrument by hypodermic needle since only very small quantities are required. The test-tube or ampoule is generally so shaped that it is impossible to get the last 0.2 or 0.3 ml of the expensive liquid into the needle, consequently this portion of the sample is lost so far as calibration is concerned.

A laboratory technician of Humble Oil & Refining Co. conceived the idea of using the conical tip of a centrifuge tube as the calibration sample container, the tip being cut off at approximately the 2.5 ml mark, as shown in Fig. 2. With this expedient, it is possible to pull all the sample into the needle, thereby eliminating waste of valuable sample.

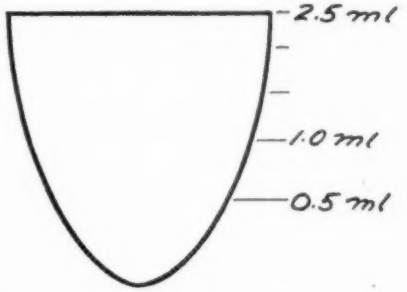

Fig. 2—Conical tip of centrifuge tube makes a good container for small samples of pure hydrocarbons for spectrometer calibrations

Wanted — IDEAS!

Plant operators, foremen and superintendents are invited to send in their own contributions of "how we do it around our refinery". Possible subjects could include maintenance and repairs ideas, inspection procedures, operating shortcuts — anything which has made your refinery more efficient and easier to run. Include photographs, drawings or sketches, if available.

Material accepted for publication will be paid for at our regular space rates. Contributions should be addressed to:

Plant Practices Editor
National Petroleum News
Technical Section
1213 West Third Street
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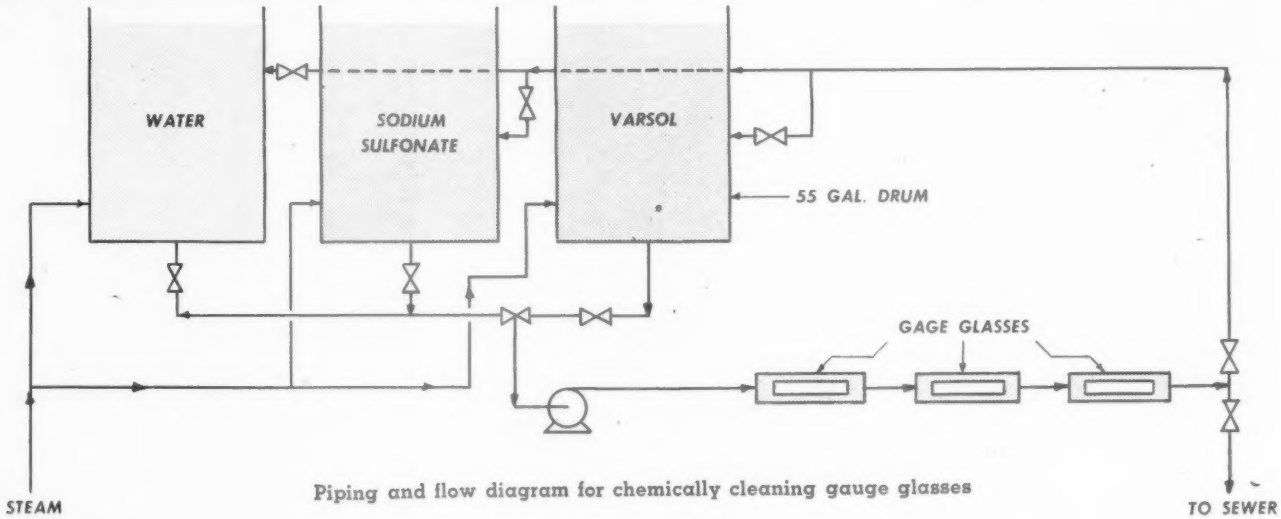
Chemical Cleaning of Gauge Glasses Saves Time, Is Safer



Piping and flow diagram for chemically cleaning gauge glasses

One of the common "chores" about a refinery is the cleaning of gauge glasses, which generally become fouled up with many kinds of deposits extremely difficult to remove. The common method of cleaning them quickly is by a low-velocity sand-blast, which does the job but has two serious objections: (1) the glass quickly becomes roughened, thereafter requiring such frequent cleaning that, after a few times, it is cheaper to replace than clean it; (2) the gauge must be dismantled for cleaning, which takes time, requires gasket renewal and increases the possibility of glass breakage when removing the gauge tube.

The instrument shop at Humble Oil & Refining Co.'s Baytown refinery has installed a device for cleaning gauge columns which uses steam, water, sodium sulfonate and "Varsol" as the cleaning agents. ("Varsol" is Humble's brand name for a special chemical cleaning compound now commercially marketed and originally developed by their research laboratories.)

The installation, as shown in the sketch above for clarity, consists of small tanks containing water, sodium sulfonate and "Varsol," in the bottoms of which are coils for steam-heating. A small centrifugal pump takes suction from a header to which the three small tanks are connected, discharge going to one or more gauge columns connected in series.

By placing a number of gauge columns in series, almost any number can be cleaned simultaneously without necessity for dismantling them. It is possible, so the company states, to clean a gauge glass in 20 to 30 minutes less time—on the average—than is required to dismantle and clean by hand. Besides savings in gaskets and broken glasses, safety features are involved, since it is unnecessary for the workman's hands to come in contact with the cleaning solutions and he is not in danger of being cut.

Manifolded Gage Tester Permits Quicker, More Accurate Check of Pressure Gages

Substantial savings in the time required for testing pressure gages are achieved at the Trenton (Mich.) refinery of Socony-Vacuum Oil Co. by using a manifolded gage tester.

The tester, shown in Fig. 4, was designed in the company's Instrument Department by Paul Heberer, instrument foreman. It consists essentially of a standard pressure gage tester mounted on a table, and a set of standard testing gages, all permanently mounted on a panel behind the table and connected to a common manifold, which in turn is connected to the gage tester. A valve between each testing gage and the manifold line permits selection of the proper gage for the range of the refinery gage being checked.

A schematic diagram of the setup is shown in Fig. 5. All piping used is ¼ in.

Advantages of the manifolded pressure gage tester are primarily two: First, it saves the time of attaching a standard

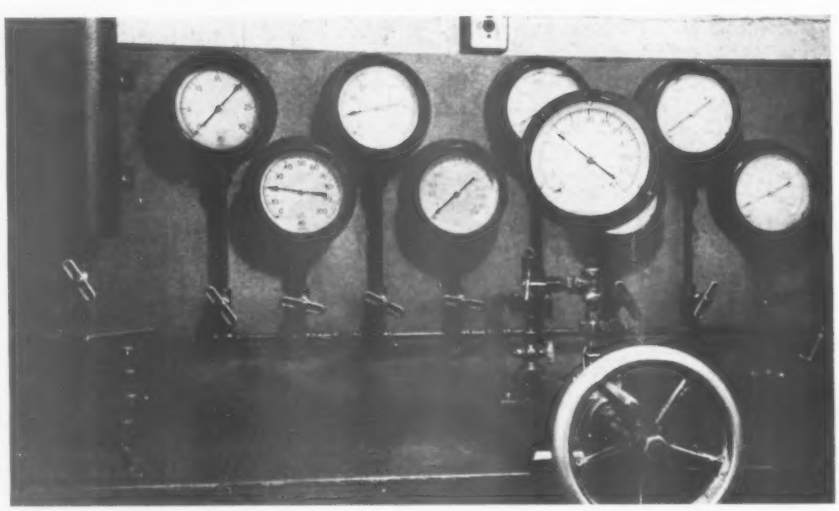


Fig. 4—Manifolded pressure gage tester at Socony-Vacuum's Trenton (Mich.) refinery, with a refinery gage (in the forward port on the tester) in position and being tested. The valves to the three left hand testing gages on the panel in the background were all open when this picture was taken, to illustrate how one testing gage can be checked against another. Actually, the second gage (100 lb. max. pressure) is the correct one to use in this case. None of the other gages visible read zero because they were closed off with a slight amount of pressure on them to prevent air pockets from forming

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A detergent and dispersant type additive, Santolube 203-A minimizes ring sticking by dispersing, or suspending, lacquer, sludge and other insoluble oil contaminants. It is extremely effective in compounding medium detergent, or dispersant, oils, because of its very low dispersancy values. It affords additional blending economies due to its pour-depressant action.

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checking gage each time a refinery gage is to be checked. Second, it preserves or maintains the accuracy of the checking gages longer since they do not have to be handled, with the danger of being bumped or knocked around.

The only changes which had to be made on the gage tester itself consisted of adding a few additional fittings to the two ports where the refinery gage (the one being tested) and the standard gage (against which the refinery gage is checked) are normally attached.

A short nipple was screwed into the rear port and a "tee" attached to the top end of the nipple. The right angle outlet of the tee was connected to the manifold line. A second nipple in the top outlet of the tee connects to a Metric valve, the open port of which is used for attaching very sensitive checking gages (R.V.P. gages, for example) which it isn't desired to mount permanently on the test panel.

The front port of the gage tester, to which are attached the gages to be checked, is fitted with a nipple, union, nipple and valve (in that order), selected so that the final top outlets of both the forward and rear ports are on the same level. This same level is essential, the instrument engineer explained, to eliminate any error which would be introduced by a difference in head when testing the very sensitive gages.

In normal operation, the gage to be checked is attached to the front port of the tester and all of the valves are closed except the one connected to the standard gage with the proper range. If a very sensitive gage is being checked, the checking gage is attached to the rear port, with that valve opened and all the others closed.

After a gage is checked, the valve to the checking gage is closed while there is still a small amount of pressure in the system. This is done to prevent any air pockets from forming in the line.

An oil reservoir is also connected to the manifold so that the gage tester can be purged of any air in it without dismantling. This purging is accomplished by closing all the valves except the one on the rear port. The valve below the reservoir is then opened slightly until oil just appears at the tops of both ports, indicating that all air has been expelled.

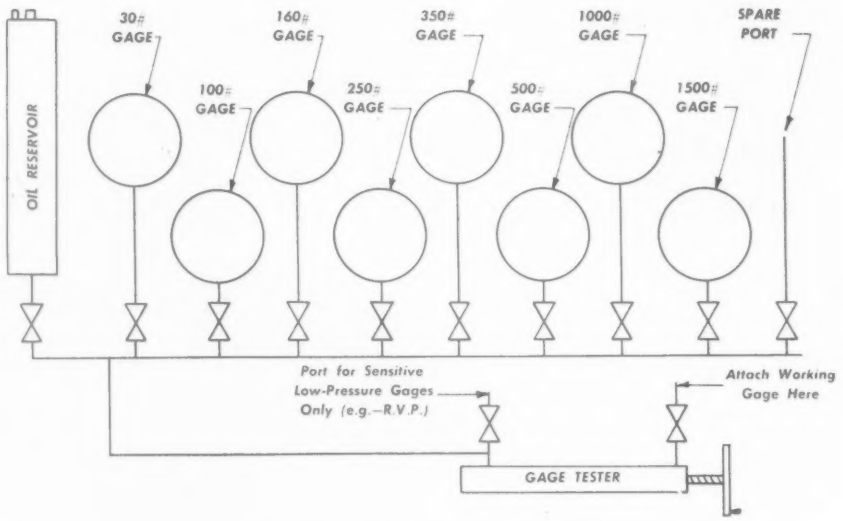
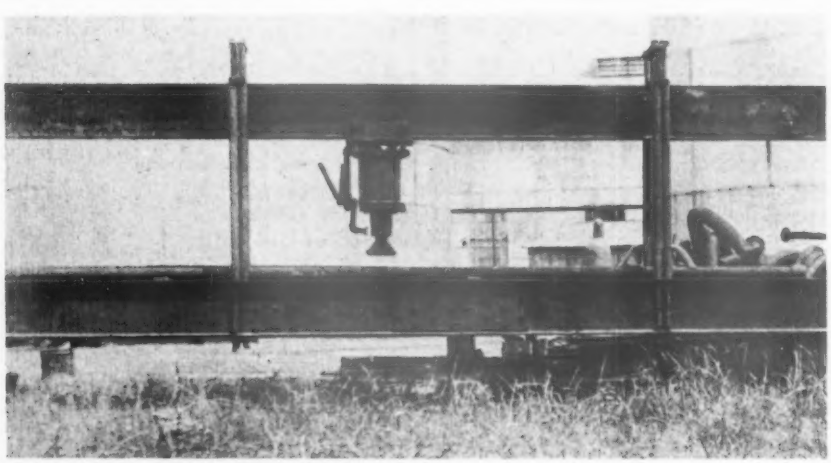
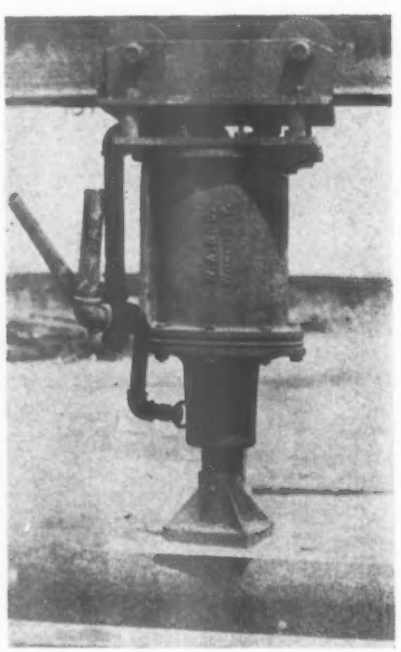


Fig. 5—Schematic diagram of manifolded gage tester designed and in use at Socony-Vacuum's Trenton (Mich.) refinery

Pneumatic Pipe Straightener Irons Out Kinks With Aid of Freight Car Brake Cylinder

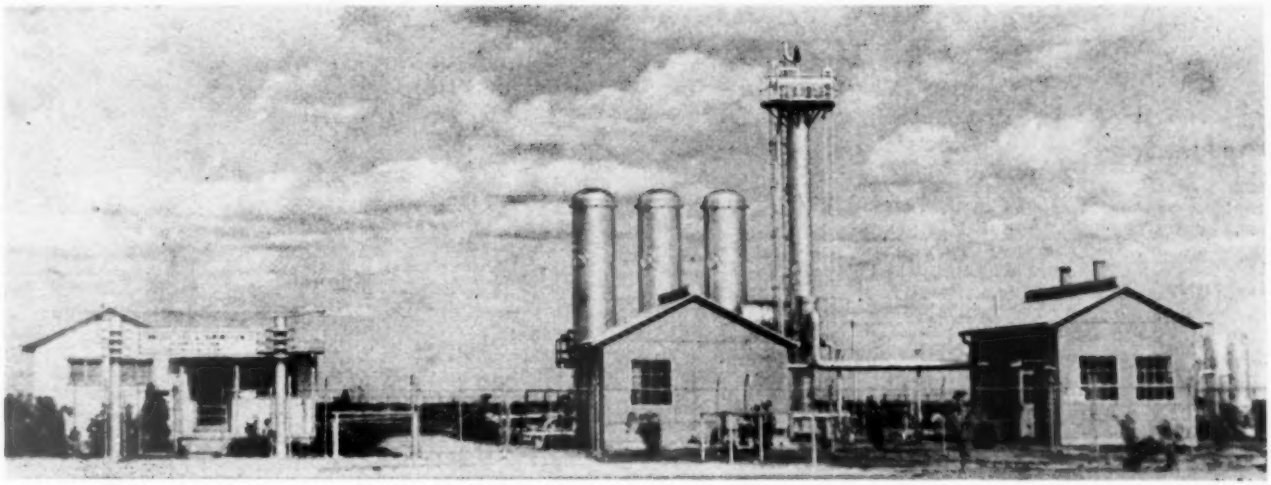
By BERNARD I. BELL—Houston Refinery, Sinclair Refining Co.





Utilizing plant air pressure, the device shown above easily straightens bent tubing by pressing it as it lies on rollers in the framework shown. The framework is of I-beams, one at the top on which the pressure unit is suspended by rollers, and two below between which are mounted at intervals concave shaped rollers on which pipe can be moved.

The pressure unit, shown in the close-up view at the right, is a standard 10 by 12 in. freight car brake cylinder, with a square foot pinned to the piston shaft. A two-way valve is used to admit air to the unit and to vent the air from the unit. The piston rises under the force of a spring within the unit. The roller-tracks extend for some distance beyond each end of the heavy framework to facilitate placing heavy or long pieces of pipe on the rollers.



General view of Tennessee Gas & Transmission Co. Agua Dulce, Texas, gas dehydration plant. Left to right: Office building, pump house and boiler house; three short towers left of center are diethylene glycol contactors, tall tower is glycol still

New Glycol Dehydration Plant Reduces Gas Dew Point 50°

THE Agua Dulce, Texas, diethylene glycol gas dehydration plant of Tennessee Gas & Transmission Co., has three contactors which together can handle a maxium of 300,000,000 cu. ft. of gas per 24 hours at a working pressure of 840 psig and reduce the dew point approximately 50°F. In January and February the plant removed an average of better than 28 lbs. of water from every million cubic feet of gas handled. This represents more than 1000 gals. per calendar day.

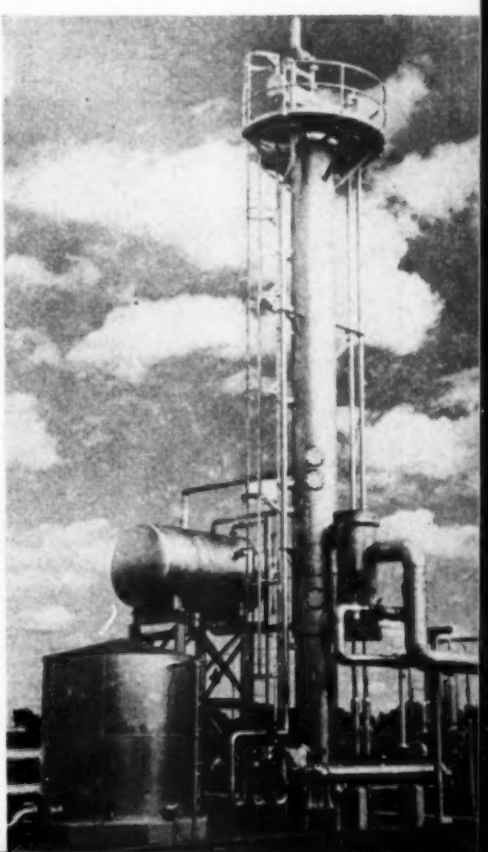
Stated specifically, gas enters the plant with a dew point of 78-80°F. and leaves with a dew point of 28-30°F. This is sufficiently low to prevent gas hydrate formation which would block the line if permitted to accumulate and not removed either by raising the gas temperature or reducing the line pressure.

The gas enters the pipeline system through a flow-meter and regulator setting at 760 psig after passing through the three-contactor dehydration battery in parallel flow, where it is intimately contacted with the hygroscopic agent, diethylene glycol. The contactors are 78 in. in diameter, have a net shell height of 31 ft. 6 in. and wall thickness of 1-15/16 in. Each contains two "Mist-D-Fier" sections, an expanded metal lath section, 4 bubble trays and one chimney tray.

Removed by Liquid-Level Control

Glycol at approximately 80°F. and 300 psig, rich with water, is continuously removed from the contactors by a liquid-level control mounted on the chimney tray of the contactor. It enters a battery of 7 shell-and-tube exchangers connected in series, where in counter-current flow it picks up 68° in temperature before leaving the battery between the second and third exchangers. Passing to a reflux condenser mounted on top of the glycol still, which can be bypassed at will with a hand control, it condenses water reflux from this still and is in turn further heated to approximately 168°F. Re-entering the battery at No. 3 exchanger, fat glycol continues to pick up heat from the out-going lean glycol until it enters the feed tray on the glycol still at about 280°F.

The glycol still is a 30-in. diameter vessel with a net shell height of 32 ft. 6 in. It contains 15 bubble trays and a chordal wier section. It is fully insulated to conserve heat gained from the vertical shell-and-tube reboiler at the base of the still. The chordal wier section serves to keep the glycol reboiler flooded over the level of the tubes. The reboiler connects to the still by 12-in. top and bottom nozzles, operates at 50 psig



The glycol still is 30 in. diameter by 32 ft. 6 in. high; has 15 bubble-trays and feed tray containing chordal wier. Reboiler at base of still is vertical shell-and-tube type. Drum to left of still (on supports) is lean glycol surge and exchanger at top of still is fat glycol-to-water reflux condenser

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R-422

New Glycol Dehydration Plant

Closeup of regulators at dehydration plant of Tennessee Gas and Transmission Co. at Agua Dulce, Texas

working pressure and 550°F. The heating medium is Dowtherm.

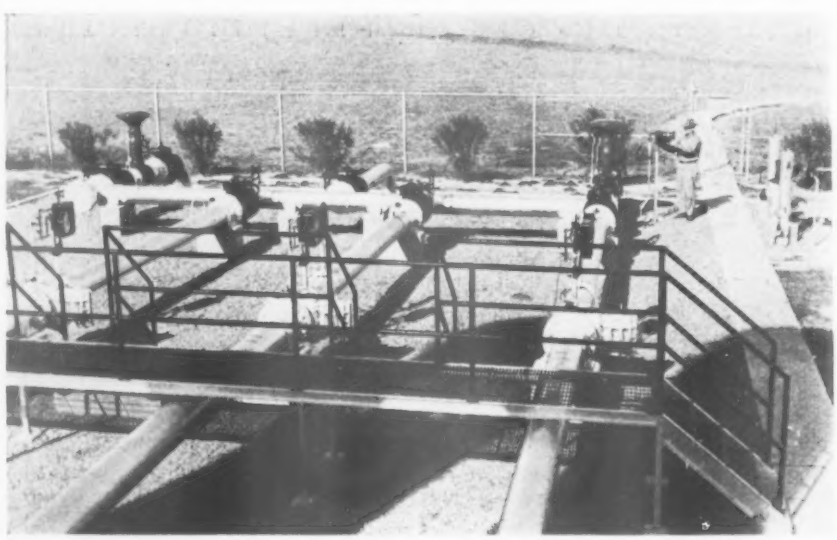
Lean glycol leaves the base of the still at 320°F., passing into a 60-in. diameter surge tank which serves to maintain an even head on the lean glycol through the exchangers and to the lean glycol pump. The tank, mounted on a structural steel support, also acts as an additional reservoir spare for the base of the still.

Leaves Exchangers at 123°F.

Lean glycol leaves the heat exchangers at a temperautre of 123°F., and is delivered to the glycol-gas contactors at about 800 psig. Pump used for this service is 3¾ by 5 in. triplex plunger-type, driven by a 50 hp electric motor. Glycol is delivered to the contactors through a flow recorder-controller, the stream being split to each contactor equally by means of recording flow meters and hand controls in the individual lines.

Two No. 33-3A Dowtherm boilers supply heat to the glycol still. Each has a capacity of one million Btu per hour and is capable of maintaining the required plant capacity for a short period. Plant design, however, calls for use of both boilers under normal conditions.

Still temperature is controlled with a recording temperature controller having a thermo bulb in the base of the still. The controller operates a 2-in. throttling-type diaphragm valve in the 4-in. Dowtherm boiler return line. Plant equipment is housed in sectional-type prefabricated steel frame, corrugated steel covered buildings. Recording calorimeter and galvanometer on the exit gas stream are housed in a portion of the office building.



Meter run at dehydration plant. Here 28-30° F dew point gas from contactors is metered, regulated to 760 psig and introduced to TGT's transmission line

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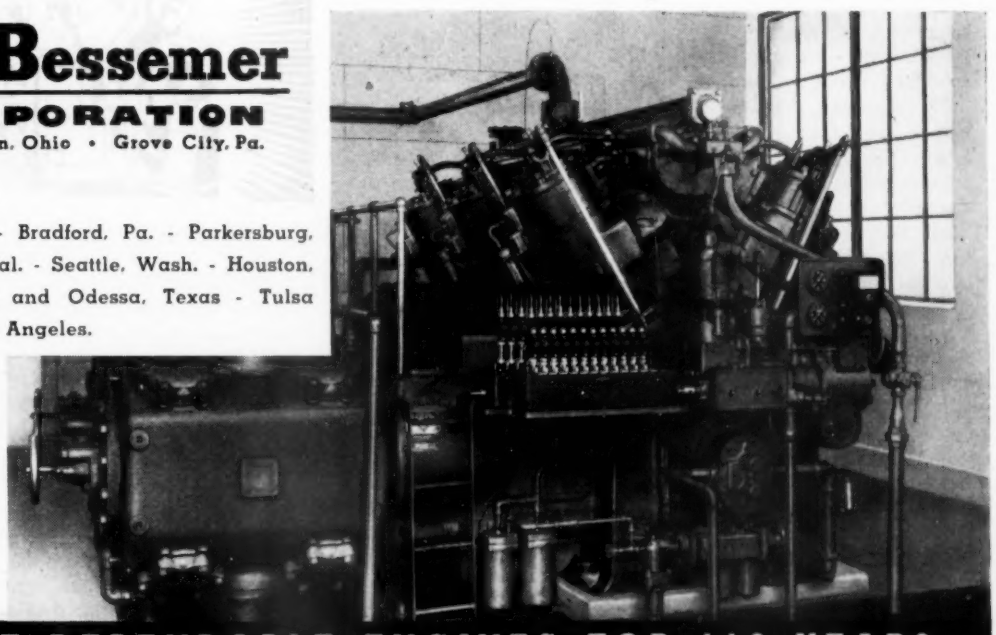

The photograph at the right shows a 6-cylinder, 375 hp Cooper-Bessemer GMX compressor unit driving three compressor cylinders.

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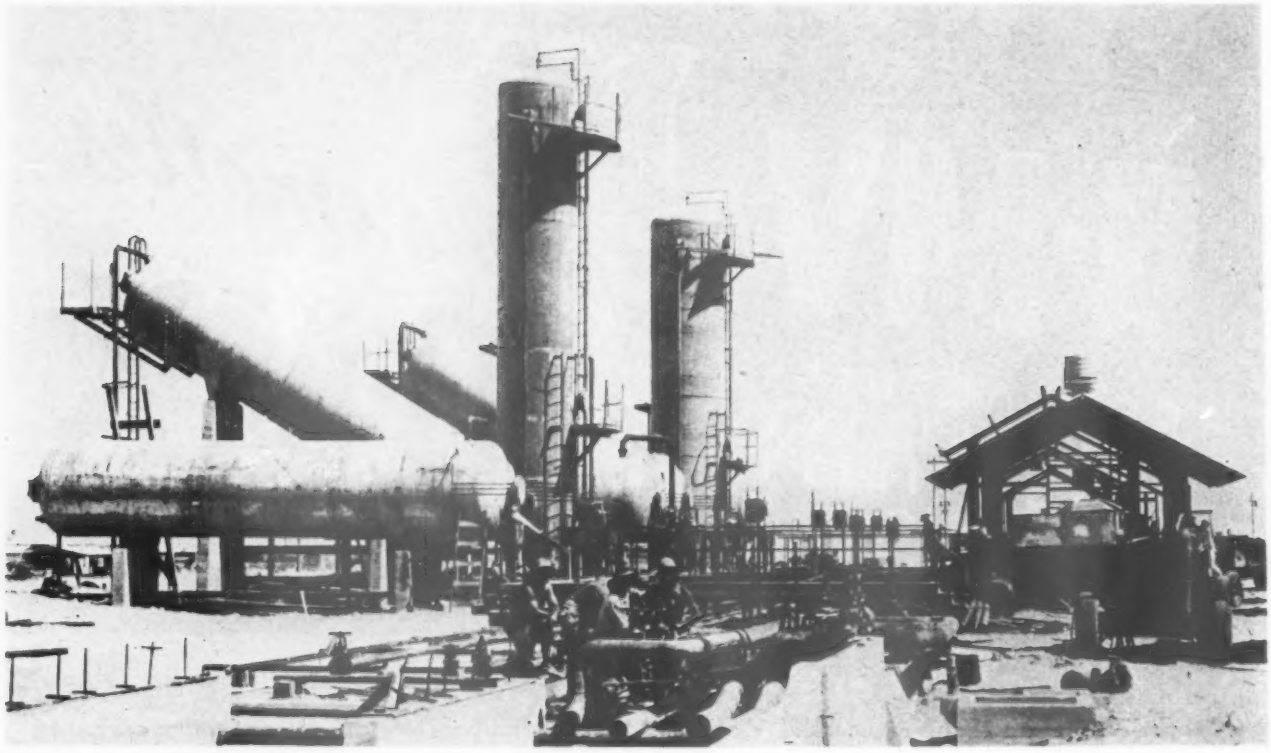

Authenticated News Photo

Installing Settlers at 45-Degree Angle Facilitates Pumping Out PbS Sludge

IN THE Arabian American Oil Co.'s new refinery at Ras Tanura in Saudi Arabia, the settling vessels in the two gasoline sweetening plants have been installed at an angle of 45° to facilitate pumping out the lead sulfide which accumulates in the operation.

"It had been found experimentally that the PbS sludge is difficult to remove from enclosed vessels unless they are constructed in such a way that the sludge can flow toward the suction," said J. B. Stoddard, of the Arabian American Oil Co. office in San Francisco.

"The suction line on these vessels is at the lowest point and the angle of repose of slurries of PbS in gasoline is less than 45° and, therefore, when suction is applied at the bottom of these vessels, the slurry can be pumped out. On the other hand, if the vessels were vertical, a vertical flow component would interrupt the operation of Stokes Law in settling PbS precipitate and, therefore, this compromise of 45° angle was arrived at."

Conventional practice in the construction of agitators for treating lubricating oils has been to make the pitch of the cones not less than 45°, in order to avoid the possibility of heavy sludge deposits.

There are eight vessels in the two gasoline sweetening plants of the Ras Tanura refinery, illustrated in the accompanying picture. Not all of the vessels, however, are clearly shown in the photograph. The horizontal tank in the foreground is the gasoline-doctor solution contactor. Next is the 45° angle gasoline-PbS settling vessel. The vertical tank next to it is the gasoline-PbS slurry contactor. The horizontal tank adjacent to the vertical tank is the gasoline-caustic contactor.

This last named tank is not part of the sweetening plant flow. It is a pre-caustic contactor for the purpose of removing hydrogen sulfide from gasoline prior to sweetening. These vessels are tied into the rundown lines from the processing units and gasoline goes directly from the vessels to unsweetened gasoline storage.

These tanks comprise the No. 1 sweetening plant. The similar installation of tanks in the rear is the No. 2 sweetening plant.

Construction of the Ras Tanura refinery started late in 1944. Its capacity is 50,000 b/d and it is to run on oil brought in from the Damman field by pipeline. The crude is first to be stabilized to remove hydrogen sulfide. Main processing equipment in the refinery includes two 25,000 b/d stills for the initial separation of the crude, and two thermal units for reforming the straight-run gasoline.

The Ras Tanura refinery site is 12,000 miles from the home office of the Arabian American company in San Francisco and practically nothing was available locally to assist in its construction. Aside from rock and sand, all material had to be imported. The main force of skilled construction workers, brought in from the U. S., was supplemented by a large number of Arabs, who first had to be trained for the work they were to do. The refinery will be self contained as far as all public utilities are concerned.

The plant was designed for a cooling water temperature of 95° F., which is quite generally reached through the summer months. The water is pumped from the Persian Gulf. Because of the high temperatures, an unusual amount of cooling water is required, the system being designed for a maximum demand of 70,000,000 gals. a day.

Germany's FISCHER-TROPSCH Process

A Summary of Latest Developments and Operating Procedures

By Ernest Cotton
Member, U. S. Technical Oil Mission
Process Engineer, Gulf Oil Corp.

American oil technologists investigating Germany's industrial development at the collapse of the Axis powers paid particular attention to the Fischer-Tropsch process, which has long attracted the attention of our industry as a means of producing synthetic liquid fuels. The process was used extensively during the war by the Germans, its originators, for the production of Diesel fuel, motor gasoline and some chemicals.

In this article one of the technologists who studied Germany's development in the Fischer-Tropsch synthesis summarizes the findings of the investigating teams. He discusses commercial methods of preparing and purifying the synthesis gas, manufacture of the catalyst, type of reactors employed, the actual synthesis procedure and the products obtained. Also covered are the iron-type catalysts which were under development and which, because they promote yields of higher-octane gasoline, are of most interest in this country.

EARLY in 1945, while the fighting in Europe was still going on and the Allied Forces had reached only the German border, the Technical Oil Mission (composed of technical men from the oil industry and from the Bureau of Mines) was dispatched to the front to investigate the German oil industry as rapidly as the plants were captured. One of the processes which was high on the Mission's list to investigate was the Fischer-Tropsch process for the production of synthetic fuels from carbon monoxide and hydrogen.

It is not proposed here to describe in detail all of the Fischer-Tropsch plants in Germany. Operations from plant to plant differed somewhat, but the major part of the differences were of the type which would be found in this country if a study is made of the thermal cracking process, for example.

Synthesis Gas Manufacture

The normal synthesis gas required for the process is a mixture of two volumes of hydrogen and one volume of carbon monoxide. The synthesis gas was produced, in the most part, by the gasification of bituminous coal coke by the water-gas reaction. The manufacture of blue water-gas from coke was carried out in standard water gas sets, and there were no new improvements in design or operation that would differentiate the German operation from well-known American practices.

The blue water-gas is composed of about 1.25 parts of hydrogen to one part of carbon monoxide. In order to adjust the H_2:CO ratio to the 2:1 required in the process, a portion of the water-gas was passed through a shift converter to convert the carbon monoxide to CO_2. A captured sample of the shift catalyst consisted of greyish-brown irregular shaped pieces of great hardness and mechanical strength, having properties as shown in Table 1.

In the shift converters steam and water-gas are passed over the catalyst at 450-500° C. The proportion of the water-gas passing through the shift converter to that by-passing it is controlled to produce the desired H_2:CO ratio in the recombined streams. The CO_2 produced in the shift converter is not removed from the synthesis gas, but passes through the Fischer-Tropsch reactors; its effect is only that of a diluent.

Since the gasification of coal is not considered of sufficient interest to the oil industry at present, the coal gasification processes will not be described. Two processes used for the conversion of coke oven gas or methane to synthesis gas are of interest, however. One is the non-catalytic cracking of coke oven gas using steam, and the other is the methane-oxygen process for the partial combustion of methane with pure oxygen.

TABLE 1—Properties of Shift Catalyst Used in Synthesis Gas Manufacture

Approximate Particle Size	½"-¾"
Bulk Density	81.2#/cu. ft.
Analysis:	
Moisture	18.0%
SiO_2	5.1%
Fe_2O_3	38.5%
Cr_2O_3	5.4%
Al_2O_3	2.5%
CaO	18.2%
MgO	5.2%
—CO_2	5.0%
—SO_3	1.9%
Difference	0.2%

The plant for the cracking of coke oven gas consisted essentially of four large steel towers lined with refractory brick and filled with refractory checker brick. Each pair of towers operated as a unit, and one unit was making reformed gas while the other was heating; thereby making the gas production from the plant substantially continuous.

The total cycle of each unit of two towers was 15 minutes, divided as follows:

1—Heating of one tower by combustion of tail gas from the Fischer-Tropsch plant. Heat removed from the combustion products in second tower and the combustion products vented to a stack ... 7 min.

2—Coke oven gas containing water vapor introduced through second tower for preheat and then into first tower for cracking. Outlet gas vented ... ¾ min.

3—Collection of cracked gas with flow as in (2) ... 7 min.

4—Combustion in second tower started but cracked gas in chambers collected ... ¾ min.

The temperature maintained in the tower during reaction was 1350-1400° C. Water for the reaction was supplied by passing the coke oven gas through a water saturation tower operating at 70° C. The principal reaction taking place is:

$$CH_4+H_2O\rightarrow 3H_2+CO$$

In the Methane-Oxygen process, synthesis gas is produced by the reaction of methane and oxygen as follows:

$$CH_4+1/2O_2\rightarrow CO+2H_2$$

Actually, the reactions in the burning zone are more complex. Some of the methane is burned to CO_2 and H_2O and some is unconverted. The general flow scheme is shown in Fig. 1.

Methane is charged by means of a blower through a tubular heat exchanger where it is heated to 400-650° C. A part

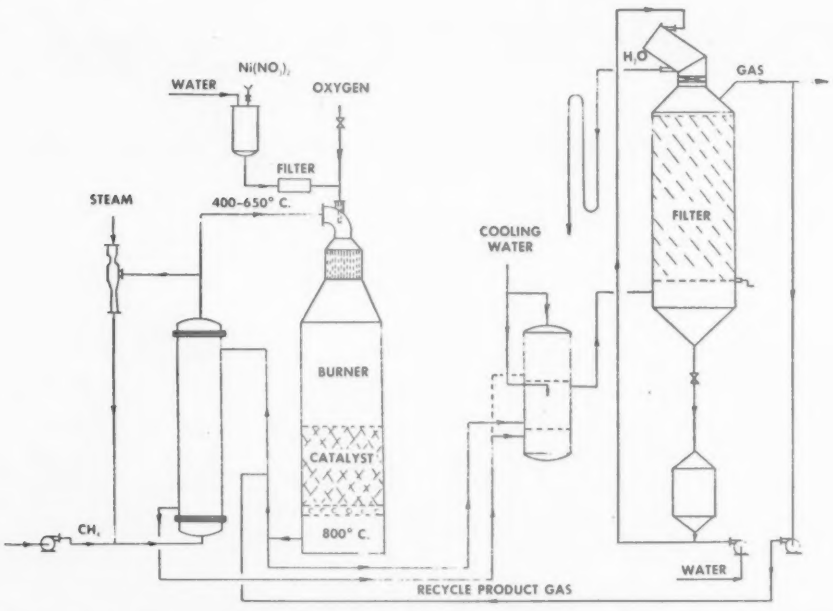

Fig. 1—Flow diagram for the Methane-Oxygen process of producing synthesis gas. In this process, methane (entering the flow diagram in the lower left-hand corner) is burned with oxygen to yield a final gas having a carbon monoxide to hydrogen ratio of about 1:3

of the gas from the outlet of the preheater is recycled to the inlet of the preheater. Feed steam (one mol steam/mol hydrocarbon) is injected into the recycle stream and serves to recycle the gases. The preheated gas-steam mixture, at a temperature of about 650° C., is mixed with oxygen at the top of the reactor in a mixing zone. Efficient mixing of the reactants is essential for satisfactory reaction.

The mixed gases have a composition within the explosive limits, and are protected from back-fire from the combustion zone by a bank of 20 mm. tubes, in which the velocity is greater than the critical extinction velocity of the reaction. Pilot flames are maintained at the entrance to the combustion chamber by the introduction of small jets of pure oxygen at the outlet of the flame arrestor. A temperature of 1200-1500° C. is reached in the combustion zone.

The products of combustion pass downward from the combustion zone through a bed of nickel-on-magnesite catalyst, where the unreacted methane from the combustion zone is converted to CO and H_2 by the methane-steam reaction. Loss of nickel from the catalyst as nickel carbonyl is replaced by introducing a solution of nickel nitrate into the combustion zone with the oxygen.

The gas leaves the catalyst bed at 800-900° C. and a greater part passes to the shell of the feed preheat exchanged. The gas leaves the exchanger at about 350° C. and is cooled in a direct spray cooler. A part of the gases from the reactor by-pass the exchanger to provide a means of temperature control of the hydrocarbon feed.

Gas from the cooler finally passes through a filter bed of ¼-in. coke for the removal of soot and tarry residues. The filter is a cylindrical shell provided with a grate for a slow discharge of the coke. The discharged coke falls through a column of water which washes off the soot. The clean coke is recycled to the top of the filter by means of a water lift, and is introduced intermittently to the filter through a slide valve.

The composition of the final gas is 7% CO_2, 23.8% CO, 69% H_2, and 0.2% CH_4.

Sulfur is the principal catalyst poison in the Fischer-Tropsch process. Therefore, it is necessary to remove it as completely as possible from the synthesis gas. The sulfur is generally removed in two steps. The hydrogen sulfide is first removed in treaters at atmospheric temperature, and the organic sulfur is then removed at elevated temperatures.

The hydrogen sulfide is removed by passing the gas through a bed of iron oxide. The hydrogen sulfide reacts with the iron to form iron sulfide. At the end of about twelve weeks the catalyst is spent and is dumped. No effort was made to recover the sulfur from the iron sulfide or to regenerate the spent catalyst.

The organic sulfur is removed by passing the gas through a mixture of 30% sodium carbonate—70% iron oxide at 180-280° C. The inlet gas is preheated in a fired heater before entering the first tower of two in series. Heat exchange is provided between the two towers as a means of temperature control. A new charge of catalyst is charged to the second tower in series. When the first tower is spent it is recharged and then becomes the second tower. About 0.25% of pure oxygen, or an equivalent amount of air, is added to the gas at the inlet of the organic purification towers in order to oxidize the sulfur to sulfates. An analysis of the spent catalyst shows that the reaction is essentially the oxidation of the organic sulfur

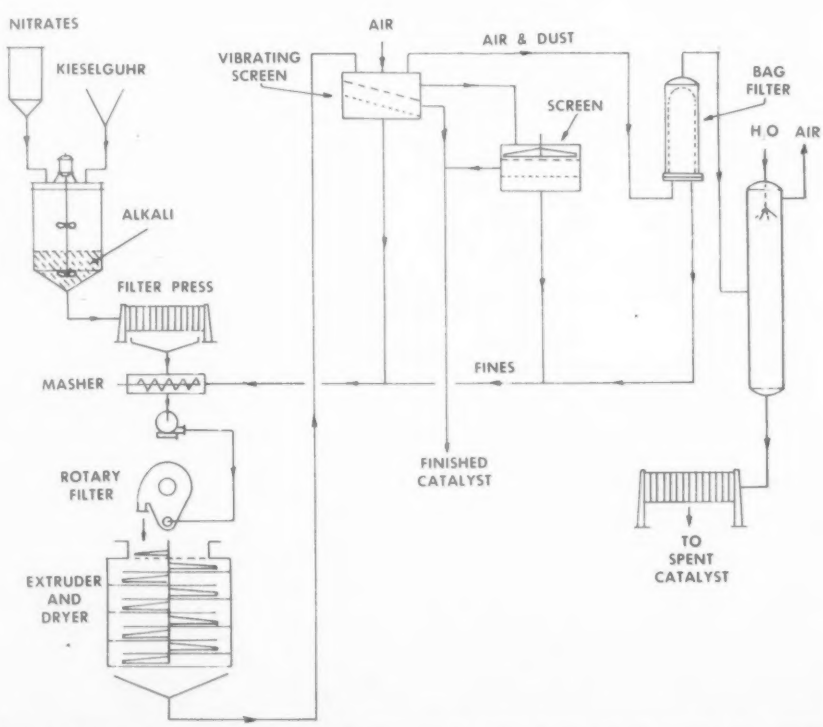

Fig. 2—Flow diagram for the production of the standard cobalt synthesis catalyst used in all of Germany's commercial Fischer-Tropsch units

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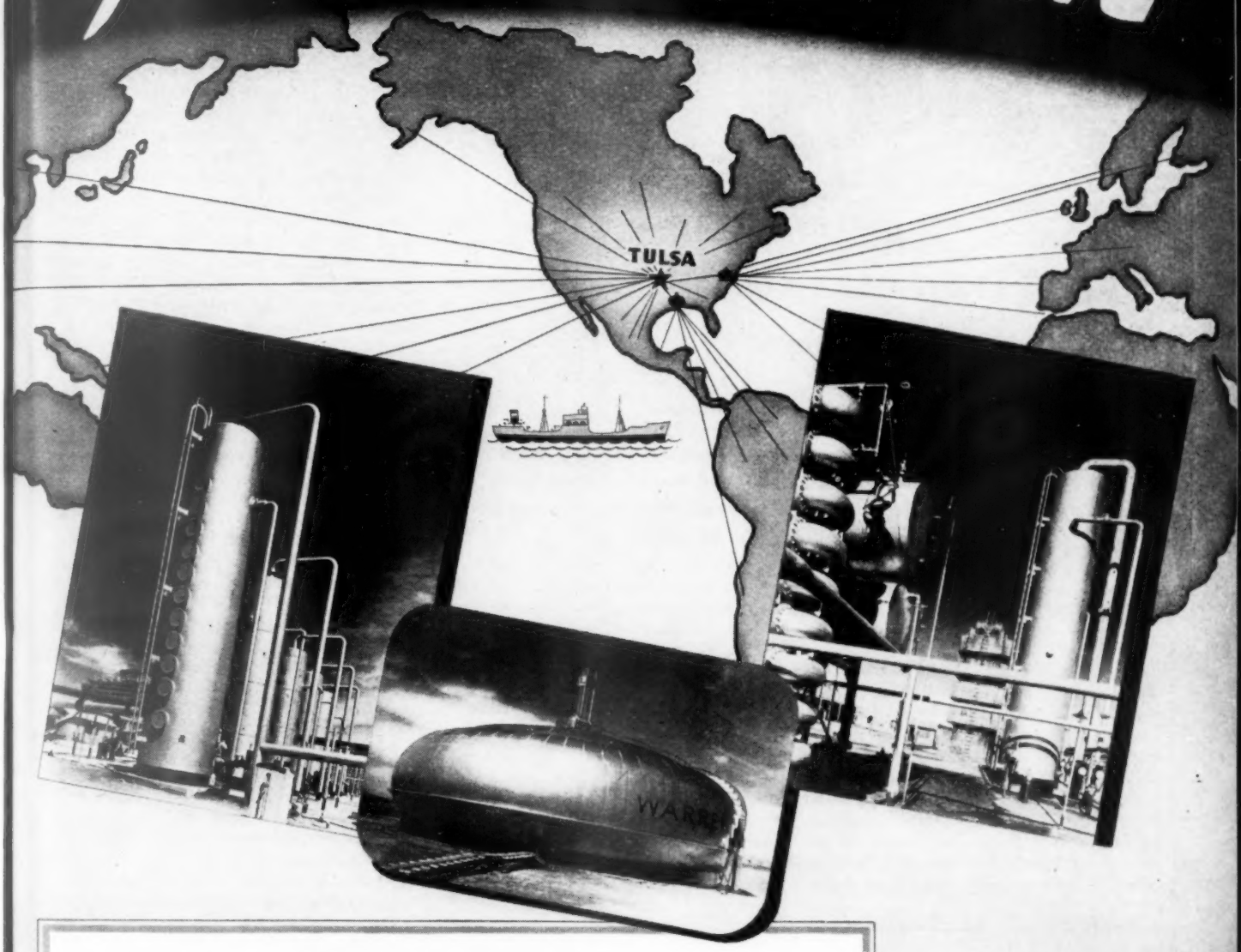

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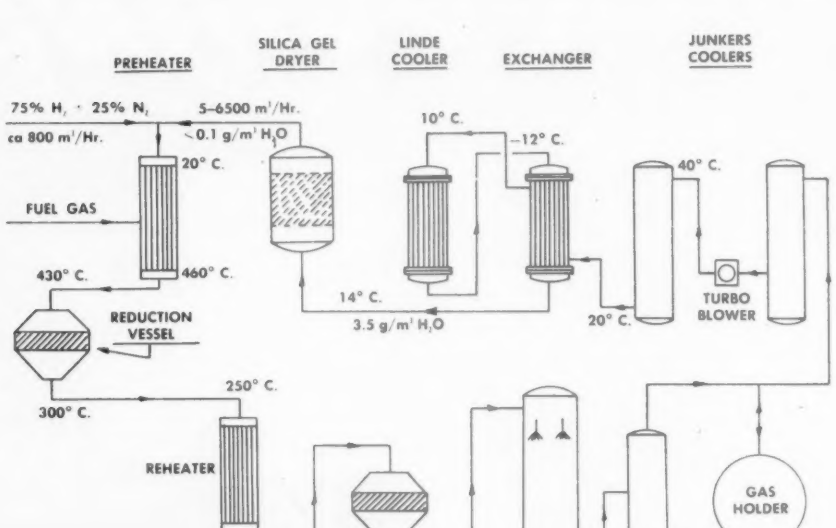

Fig. 3—Flow diagram for the reduction of cobalt synthesis catalyst. Reduction of the catalyst is carried out in the reduction vessel at the left of the diagram (also illustrated in the accompanying photograph on page R-430) by the batch process, each batch requiring 40 to 60 minutes

to sulfate and the formation of sodium sulfate in the catalyst bed.

Synthesis Catalyst

In all the commercial units in Germany the catalyst used is that known as "standard" cobalt catalyst. Essentially all of this catalyst is prepared at the catalyst manufacturing plant at Sterkrade, and is composed of 100 parts cobalt, 5 parts thoria, 8 parts magnesia and 180-200 parts of kieselguhr. Originally a catalyst containing only cobalt, thoria, and kieselguhr in the ratio of 100:15:200 was used, but the substitution of magnesia for a part of the thoria resulted in a catalyst of increased hardness, increased life, and less tendency to form methane and to deposit carbon.

The procedure for the preparation of the standard cobalt catalyst at Sterkrade (see flow sheet, Fig. 2) is as follows:

A solution of the nitrates of cobalt, thorium, and magnesium is heated to 100° C. in an overhead stainless steel tank. The contents of this tank are run into a precipitating tank fitted with a stirrer and containing sodium carbonate solution maintained at 100° C. The solution of nitrates is added very quickly to the carbonate solution and stirred for ½ minute, and then dry kieselguhr is added through the hopper and the stirring continued for another minute.

The slurry is pumped to a filter press and the cake washed with distilled water until the washwater is neutral as tested with nitrophenol. The washing requires about 15 minutes. The washed cake is then dropped into a "masher" and mixed with dust from the screening plant. The resulting cream is pumped to a rotating suction filter. The caked scraped off the rotating filter contains about 70% water. The cake is extruded through 3 mm. holes and falls directly into a 20-stage drying oven, where the catalyst is swept around each stage by rotating arms which also dump the material to the next stage. The drying is effected by steam heat and air, and requires 1½ to 2 hours to dry one batch of catalyst.

The dried catalyst from the dryer (containing about 10% water) is carried by a conveyor to a vibrating screen and separated into four sizes: over 3 mm., 1 to 3 mm., fines, and dust. The dust is sucked away in an air current through a cloth filter and then the air is scrubbed with water. The dust recovered from the cloth filter is returned to the masher. The fine catalyst recovered from the scrubber is not returned to the masher because oxidation tends to convert carbonate to oxide, which renders reduction more difficult. This material, which represents only 0.1-0.2% of the whole, is sent to the catalyst regeneration plant and treated as spent catalyst.

The material over 3 mm. size from the vibrating screen is passed to a set of screens where rotating arms force the granules through a 3 mm. screen. The dust and fines from this operation plus the fines from the vibrating screens are returned to the masher. The 1 to 3 mm. size catalyst is bagged for transportation to the reduction plant. The bulk density of the unreduced catalyst is 320-350 grams per liter.

The catalyst is reduced in a plant, as illustrated in Fig. 3. The reduction vessel comprises a central compartment of square cross-section containing the catalyst in a bed 30-35 cm. deep and 2.1 sq. meters in area, with top and bottom fittings in the form of truncated pyramids. A sheet-iron grill of 15 cm. cubes for the purpose of breaking up the gas stream entering the reduction vessel is placed on top of the bed and sinks into it to a depth of about 10 cm. Each reduction vessel contains about 800 liters of catalyst.

The catalyst is reduced by passing downward through it a stream of gas containing 75% hydrogen and 25% nitrogen, heated to a temperature of 460° C. at a space velocity of 8800. The reduction period varies from 40 to 60 minutes. The effluent gas from the reducing zone is passed through a methanization reactor where the carbon dioxide is hydrogenated to methane by passing over synthesis catalyst. The gas is then cooled, and the

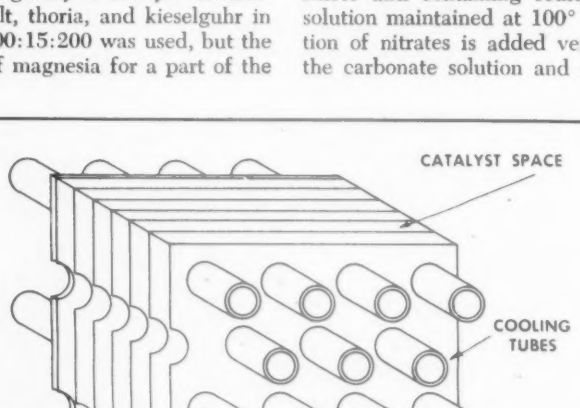

Fig. 4—Sectional drawing of a normal pressure reactor. These vessels consist of thin vertical steel plates, ⅜ to ½ in. apart, and horizontal tubes of about 1 in. diameter. Catalyst is held in the spaces between the plates and around the tubes. Water flows through the tubes

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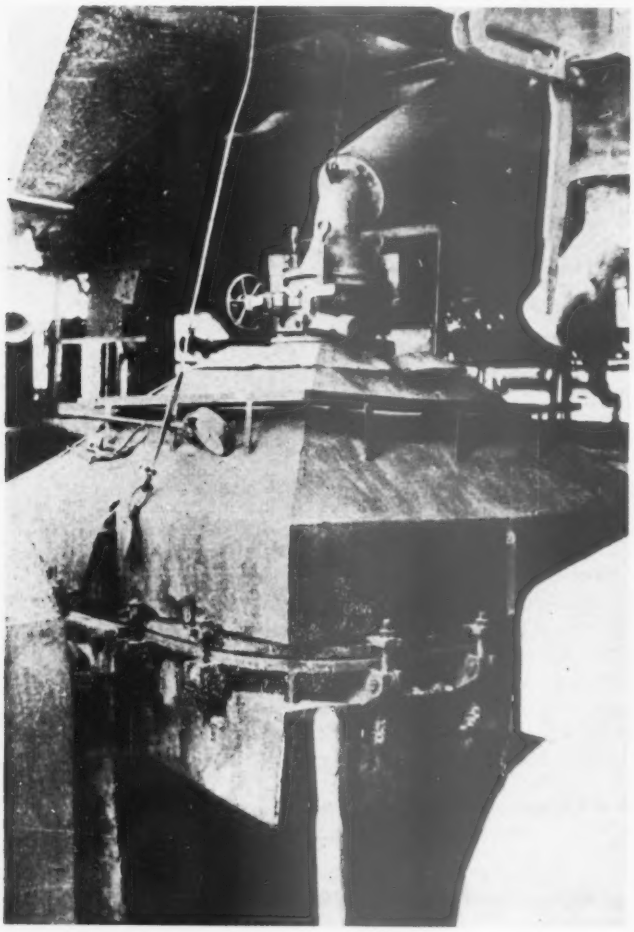

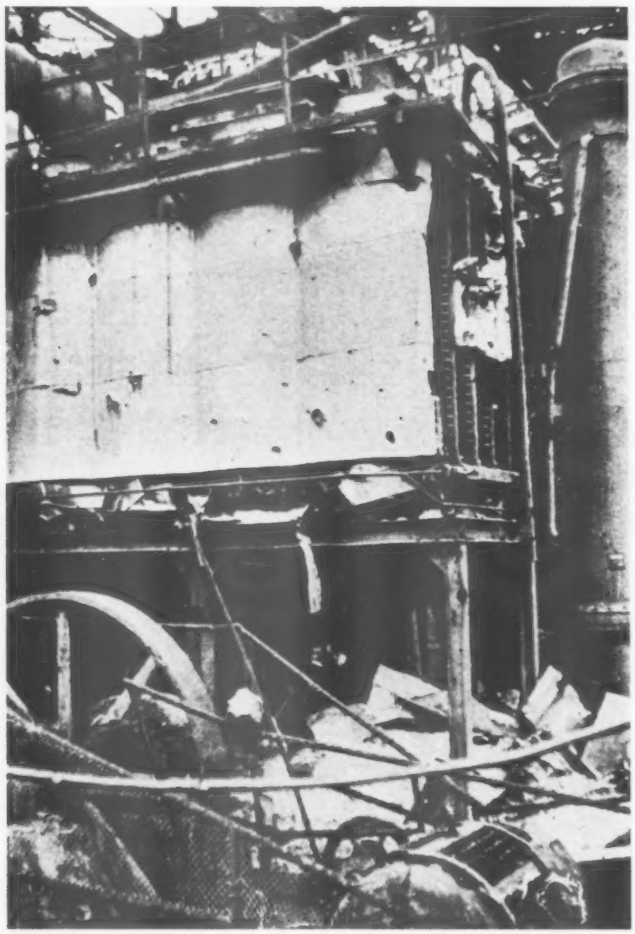

LEFT—Reduction vessel, indicated in Fig. 3, for the preparation of the standard cobalt catalyst. This vessel consists of a central compartment of square cross-section, with top and bottom fittings in the form of truncated pyramids. Reduction is effected by passing downwards through the catalyst a gas stream containing 75% hydrogen and 25% nitrogen. RIGHT—An experimental catalyst chamber at the Sterkrade-Holten plant, at which was located the research and development center for Germany's Fischer-Tropsch operations. This chamber was apparently constructed in an attempt to develop an oven that would withstand the higher pressures (20 atm.) required for the iron catalyst process described later in this article. Its design appeared to be based on the internal arrangement used for the catalyst chambers which operated at normal (4 psig) pressures. It apparently contained the thin steel plates and horizontal water tubes (Fig. 4) of the normal-pressure chamber, but the shell had been built of curved heavy steel plate sections welded together, giving the outside a corrugated appearance. Details on the operation and construction of the new type chamber are not available

water removed by refrigeration and by passing it through silica gel, and then returned to the gas preheater along with the fresh gas make-up. The temperature is controlled within 2° C., and is varied somewhat with the reduction time and the gas velocity.

In the reduction only 50-60% of the cobalt is reduced to metal. If over 60% is reduced to metal a less suitable catalyst results. The extent of reduction is measured by measurng the volume of hydrogen evolved when a sample of the reduced catalyst is treated with acid.

Following the reduction, the reduction vessel is purged with nitrogen and then with carbon dioxide. The contents are then discharged into a vessel for transportation to the plant. A total of 16 reduction charges are required to fill one reactor.

The spent catalyst from the reactor is returned to the Sterkrade for re-working by re-solution in nitric acid and reprecipitation with sodium carbonate.

The Synthesis Reactors

The synthesis is carried out commercially in Germany by what is known as the Normal Pressure and the Medium Pressure procedure.

The Normal Pressure reactors are rectangular, about 20 ft. long; 6 ft. wide and 9 ft. high, and are filled with thin vertical steel plates parallel to the ends of the reactor and spaced about ⅜ to ½ in. apart, (Fig. 4). Passing through these steel plates at right angles are horizontal tubes about 1 in. in diameter, which contain the cooling medium. The tubes are manifolded together at either end of the reactor and are connected to an overhead steam separating drum.

A water level is held in the drum, and water feeds to one of the reactor tubes by gravity. As the water passes through the tubes the exothermic heat of reaction from the synthesis vaporizes the water. The steam and water from the tubes at the other end of the reactor discharges back into the overhead drum, where the steam separates and is released through a back pressure regulator into the steam mains. The temperature in the reactor is controlled by controlling the back pressure on the steam drum.

The catalyst fills the space between the plates and is supported on a screen at the bottom. The top of the reactor is removable for charging the catalyst. When the catalyst is spent, the screen in the bottom is lowered and the catalyst removed from the V-shaped bottom by means of a conveyor. Each reactor contains catalyst equivalent to one metric ton of cobalt.

The Medium Pressure reactors are vertical cylindrical vessels similar in many respects to fixed tube sheet heat exchangers. The outside shell is 2.7 meters

Question:

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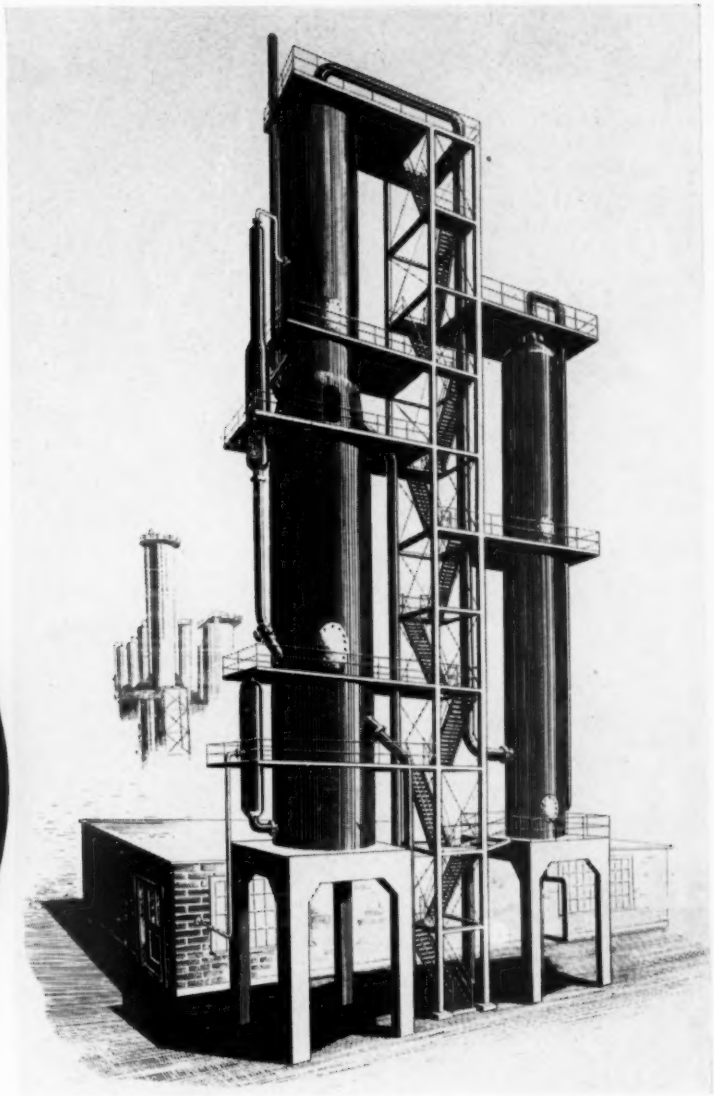

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internal diameter. Each shell contains 1984 tubes of about 48 mm. outside diameter by 44 mm. inside diameter and about 4½ meters in length, arranged on 54 mm. triangular pitch.

Inside each of these tubes, which are welded to the tube sheet at either end, is placed a core tube of about 24 mm. outside diameter. This core tube is connected through the wall of the larger tube at either end in the manner shown in Fig. 5. The water and steam cooling medium surrounds the larger tube, and is free to circulate through the core tube.

The annular space formed by the two tubes is the catalyst space. The catalyst is supported at the bottom of the tube bundle by means of a screen. When catalyst is removed the screen is lowered and the catalyst removed through the bottom manhead. The top of the reactor is a dished head flanged to the shell. The head is removed for charging the catalyst.

The synthesis gas enters the reactor at the top and flows downward through the catalyst. The reactors are arranged four in a square, and operated as a unit. The shell side of the four reactors are connected to an overhead steam separating drum. Boiler feed water is fed to the steam drum to hold a level, and the steam generated is released through a back pressure regulator into the steam main. The temperature on the reactor is controlled by controlling the steam pressure in the drum.

The Synthesis

In the Normal Pressure synthesis it is customary to operate about two-thirds of the reactors in the first stage and one-third in the second stage. Synthesis gas is supplied direct from the organic sulfur purification unit at a temperature of 150-160° C. and at a pressure of about 4 psig. The gas charge rate is about 1000 cubic meters of ideal synthesis gas per hour per reactor, ideal synthesis gas being defined as carbon monoxide and hydrogen only. As the catalyst decreases in activity the charge rate is also decreased and the temperature increased. The effluent from the first stage passes through a direct water cooler and in some cases through an active carbon absorber, and is charged to the second stage without any addition of fresh synthesis gas.

Freshly charged reactors in some cases are placed on tail gas from the second stage for two or three days, but in general new reactors are placed in the second stage. The operating temperature is controlled to give about 50% contraction in each stage. The initial operating temperature is about 185° C. At the end of 30-35 days, when the required operating temperature has risen to about 192° C., the reactor is placed in the first stage. The initial operating temperature in the first stage is about 185° C. The temperature rises in about three weeks to 190-191° C.

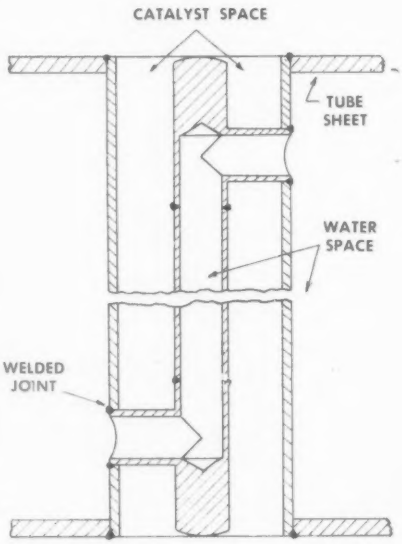

Fig. 5—Tube assembly for the medium pressure reactor used in Fischer-Tropsch operations. These reactors operate at a pressure of about 150 psig, as compared with a 4 psig pressure for the normal pressure vessels

at which time the reactor is taken off the line and the catalyst washed with 28 cubic meters of Fischer-Tropsch gasoline by allowing the gasoline to trickle down over the catalyst for a period of 7 hours. The reactor remains in the first stage about 120 days, with subsequent solvent washings at 14-day intervals. The total catalyst life is thus 150 to 160 days. Catalyst life varied considerably from plant to plant, from about 4 months to 7 to 8 months. This was due largely to differences in individual operating procedures.

In some plants the catalyst was treated with hydrogen instead of solvent, at 14-day intervals. This was very effective in most cases, but it destroyed the hard wax instead of removing it, and therefore was not favored by most of the plants. In the hydrogen treatment pure hydrogen at 200° C. is passed over the catalyst in the reactor for eight hours at a rate of 1500 cubic meters per hour. In one plant it was reported that the initial temperature after hydrogen treatment dropped to 176-177° C.

The products from the two stages are condensed in direct-condensation towers packed with stoneware rings, and fed with water which is recycled through a cooling tower. The C_1-C_4 acids dissolved in the water and the acid water is replaced with fresh water to the extent necessary to maintain not more than the equivalent of 1 gm. of acetic acid per liter. The C_5-C_{15} acids remain dissolved in the oil. The uncondensed gas from the direct condensers passes through active carbon absorbers for the recovery of C_3 and C_4 hydrocarbons.

The average yield of C_3 and higher hydrocarbons varies between 135 and 150 gm./cubic meter of ideal synthesis gas. The methane produced is about 14-15% of the total products. The C_3-C_4 cut is about 15% of the total products and is composed of 16% propylene, 49% propane, 26% butylenes and 9% butanes. The remaining liquid consists of about 50% 160° F. end point gasoline, 20% 160-230° C. diesel oil, 20% 230-320° C. heavy oil, and 10% wax.

The Medium Pressure synthesis procedure differs from the Normal Pressure procedure mainly in the operating pressure. The reactors operate under 150 psig, as compared to about 4 psig for the Normal Pressure synthesis.

The general procedure with the Medium Pressure synthesis is to operate the reactors in three stages. About half of the reactors are in the first stage; one-fourth in the second stage; and one fourth in the third stage. This ratio is varied somewhat, however. The gas entering the first stage has a hydrogen to carbon monoxide ratio of 1.4:1. The liquid product from the first stage is condensed in an indirect condenser, and sufficient hydrogen-carbon dioxide mixture from the shift converters added to the uncondensed gas to increase the hydrogen to carbon monoxide ratio to 1.6:1 before it enters the second stage. The effluent from the second stage is again cooled in an indirect condenser for separation of liquid product, and additional converter gas added to increase the hydrogen to cargon monoxide ratio to 1.8:1 before entering the third stage. The effluent from the third stage is condensed by a direct water condenser and the C_3-C_4 hydrocarbons absorbed in active carbon plant.

For the first stage the inlet gas rate is 1000 cubic meters/hour per reactor, the temperature 180-200° C. and the gas contraction 50%. Similar conditions are maintained in the second stage. In the third stage, where reactors containing fresh catalyst are usually started, a feed rate of 2000 cubic meters/hour per reactor is used with a temperature of 165-185° C. The overall contraction is about 75% and the yield is 150 gm. of C_3 and higher hydrocarbons per cubic meter of ideal synthesis gas.

The products are as follows:

C_3 and C_4—10% (40% olefins with 13% of C_4's being isobutane)

C_5-170° C.—25% (24% olefins and about 45 O.N. MM)

170-280° C.—30% (9% olefins)

280-340° C.—20% (Soft Wax)

Residue—15% (Hard Wax—M. P. about 90° C.)

The procedure of entering the first stage with a synthesis gas relatively lean in hydrogen and increasing the hydrogen to carbon monoxide ratio by the addition of converter gas, results in a lower production of methane. The methane production with the above procedure is about 10% of the total hydrocarbons, while it is

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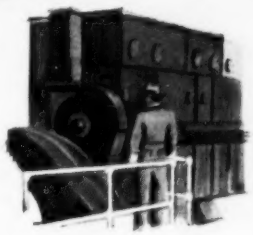

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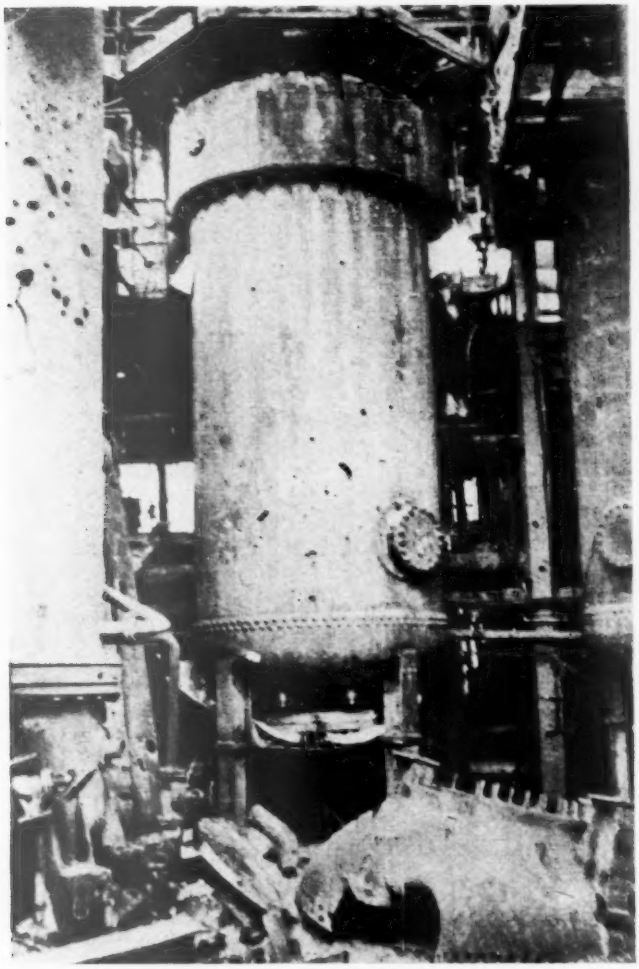

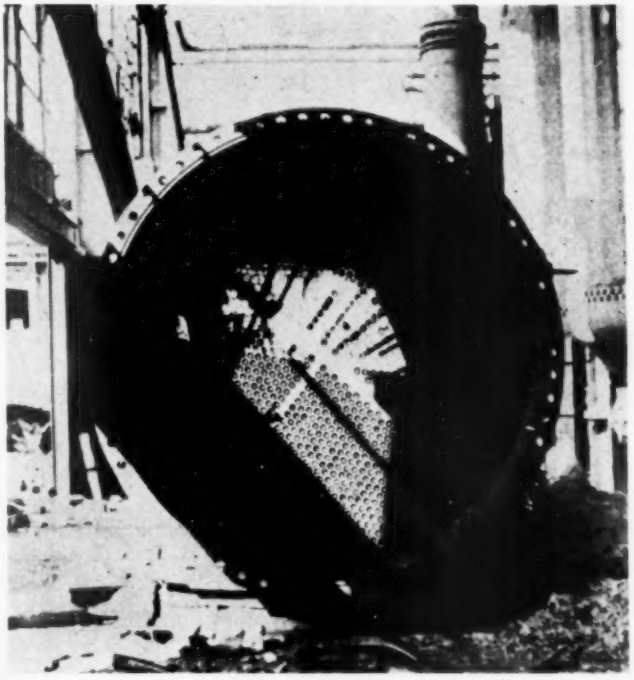

LEFT—A medium-pressure catalyst chamber in its installed position at the Sterkrade-Holten plant

ABOVE—A partially-dismantled medium-pressure synthesis reactor of the type shown at the left. This vessel, lying on its side outside of the converter house, was apparently in the process of being retubed. Details of the tube arrangement are shown in Fig. 5

14% when using normal synthesis gas charge in the first stage without enrichment between stages.

In general, the C_3 and C_4 olefins were converted to alcohols or other chemical derivatives, and the residual paraffins were liquefied and sold in cylinders for motor fuel. The gasoline was used for motor gasoline, since it was usually not better than 50 O.N., I.G. Research method. The diesel fuel cut, in general, was blended with other diesel fuels from coal hydrogenation, etc. Some of the heavier material was sulfochlorinated to produce detergents, or was converted to synthetic lubricating oils. The paraffin wax was, in general, used for the production of soaps and edible fats.

Gas Recycle Operation

The most interesting modification of the process using cobalt catalyst was to be tried out commercially at Sterkrade. The equipment had been installed for the operation, but the bombings had destroyed the plant before the large-scale operation could be started. Sufficient information had been obtained on pilot plant operation to warrant the installation of the full-scale equipment.

The plan was to use all the Medium Pressure reactors in parallel in one stage. The object of this method of operation was the production of olefins by maintaining a high concentration of carbon monoxide in the synthesis gas to the reactors. When attempts had been made to use a synthesis gas of high carbon monoxide content at normal charge rates, carbon deposition had resulted. The use of high gas rates with recycle apparently avoided the carbon deposition. The recycling served to increase the carbon monoxide to hydrogen ratio from 1:1.25 normally occurring in water gas, to 1.25:1. This is illustrated as follows:

	Parts H_2	Parts CO
Fresh water-gas	1.25	1.00
Consumed in reaction	1.00	0.50
Residual gas	0.25	0.50
3 volumes of residual gas	0.75	1.50
1 volume of fresh water-gas	1.25	1.00
Total reactor feed	2.00	2.50

The reaction temperature for the process was higher than that normally used, 200-225° C., as compared to 180-190° C. The gas contraction was about 50% and the yield was 100-110 gm. of C_3 and higher hydrocarbons per cubic meter of ideal gas. In the pilot plant experiments a catalyst life of 6 to 7 months had been obtained. The products from the pilot plant operation were as follows:

C_3 and C_4 . . . 8% (60-65% olefins)
Gasoline . . . 30% (60-65% olefins)
Middle Oil 28% (40-65% olefins)
Wax . . . . . 34% (small % olefins)

The gasoline fraction had a motor method octane number of 50-55, but this could be increased to 70 without any gas formation, change in boiling range, or olefin content by treatment in the vapor phase over HCl treated Floridin clay at atmospheric pressure and 300° C. with a clay life about the same as for clay treating of cracked gasolines.

Iron Catalysts

As previously stated, only cobalt catalyst were in use in commercial plants in Germany. Due to the rather low octane gasoline produced, it is doubtful that the Fischer-Tropsch process using cobalt catalyst as practiced in Germany can become economically practical in United States for the production of motor gasoline. There was considerable research work being carried out in Germany on the use of iron catalysts. The Fischer-Tropsch process using iron catalyst gives a higher octane gasoline and is therefore more attractive in this country.

One very interesting development in the use of iron catalyst is the hot gas recycle process developed at Ludwigshafen. In this process, gas is circulated over the catalyst and through a cooler at such a

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rate that the temperature rise in the catalyst bed is limited to a maximum of 10° C. The reaction is carried out at a pressure of 300 psig. At lower pressures the reaction velocity is too small. The gas recycle ratio is 100 volumes of recycle to one of fresh feed. Contact time in the catalyst bed is approximately one-half to one second per pass with a gas velocity of about one meter per second.

The catalyst used is made by pasting fine iron powder prepared by thermal decomposition of iron carbonyl with 1% of borax and forming into approximately 1 cm. cubes. The cubes are sintered and reduced with hydrogen at 800-850° C. for four hours.

Reaction data for the process are given in Table 2.

The crude gasoline product has an octane number of 68-70 Research. By passing this gasoline over alumina at 400-450° C. for dehydration of the oxygenated compounds and then refining over fuller's earth at 180-200° C., the octane number is increased to 84 Research and to 75-78 Motor Method. The refined gasoline has an olefin content of about 70%. The gas oil has a cetane number of 45-50.

Another interesting development in the use of iron catalyst was the fixed bed, oil circulation process. The catalyst is placed in a fixed bed and the heat of reaction is removed by circulating a product cut of fixed boiling range over the catalyst. The heat is removed by raising the temperature of the oil as well as by partial vaporization of the oil. The process operates at a pressure of 20-25 atm. and at a temperature of 250-300° C., in the first stage and at 280-330° C. in the second stage. Synthesis gas, with a ratio of CO to H_2 of 55:45 is used. The throughput is controlled to yield 20-25 gm. of total product per liter of catalyst per hour. The catalyst used is the same as that used in the hot gas recycle process.

The yield of C_3 and higher hydrocarbons is about 150 gm. per cubic meter of ideal synthesis gas.

The products have following composition:

C_3 and C_4 ..... 16% (85% olefins)
Gasoline (to 200° C.) .. 40% (50% olefins)
Gas Oil ..... 20% (25% olefins)
Paraffin Wax 20%
Alcohols (largely C_1 and C_2) .. 4%

The gasoline contains about 1% oxygen and the gas oil about 0.5%. The crude gasoline has an octane number of 62-65 and the gas oil has a cetane number above 70.

Other methods of operation were tried but none were as successful as the two described above. Apparently fluid catalyst or fluidized fixed bed technique had not been tried in Germany. Some experiments had been made on suspending a fine catalyst powder in a heavy oil, but the experiments were not very successful due to the aglomeration of the catalyst.

TABLE 2—Reaction Data for the Fischer-Tropsch Process Using Iron Catalyst

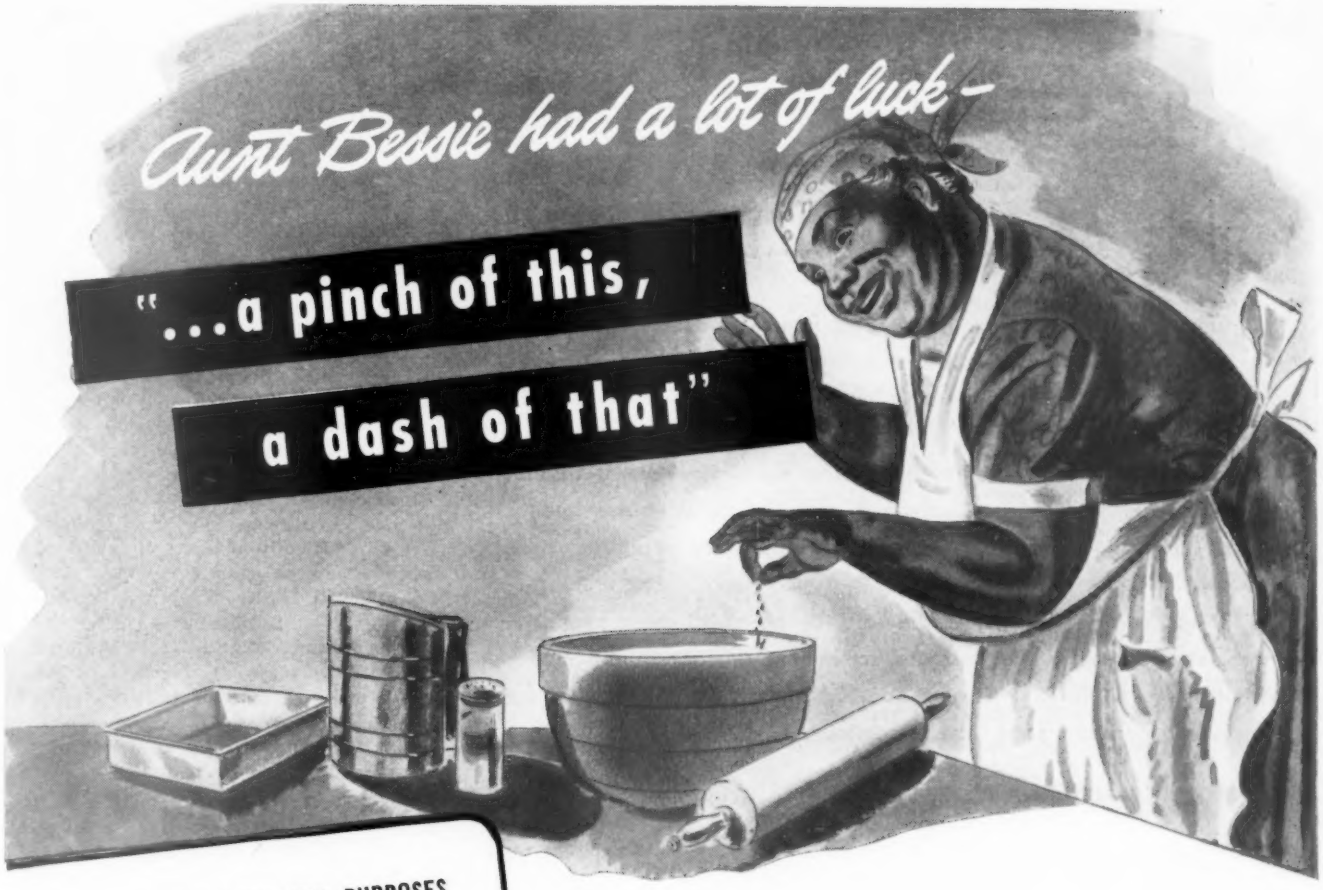
Gas	$CO:H_2$ about 1:1 to 4:5
Pressure	300 psig
Gas purity	Sulfur—2 mg/cu. meter, No. CO_2
Gas circulation	100:1
Temperature	300-325° C.
Output/cu. meter of catalyst	700-800 kg. per day
Conversion—one stage	80-85%
Conversion—two stages	92-95%
Products: (one stage —4:5 $CO:H_2$)	
Exit Gas	
CO_2	40-45%
H_2	25-30%
CH_4	5-10%
CO	15-20%
Liquid Products	
Ethylene	8%
Propylene	9%
Propane	3%
Butylene	8%) 75% iso.
Butane	2%)
Gasoline (to 200° C.)	48% (7% alcohol)
Gas Oil	14% (4% alcohol)
Paraffin wax	1%
Alcohols (removed in water)	7%

Technical Oil Mission Reports

Reports prepared by the teams of investigators who following our advancing armies into Germany are being made available to the public through the Department of Commerce, Office of Publication Board. As far as NPN's editors have been able to determine, however, no comprehensive index of these reports has been published.

The Department of Commerce does issue a weekly "Bibliography of Scientific and Industrial Reports" which lists the latest ones available and gives a brief abstract of their contents. The reports listed, however, are from all of the investigating teams, and cover many topics besides petroleum and its products. They are grouped under general classification; reports on synthetic liquid fuels, for example, will be found under both "Chemicals and Allied Products" and "Products from Petroleum and Coal." The bibliography is being issued weekly on a subscription basis; although no definite price has been established for it, "the Superintendent of Documents will accept $10 as an initial payment for the service and notify subscribers when additional remittance is necessary." The bibliography is for sale by the Superintendent of Documents, Government Printing Office, Washington 25, D. C.

Details as how to secure individual reports and their costs are given in the bibliography.



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N.G.A.A. PAPER

Condensate from Natural Gas Yields Motor Fuel Directly

By George Granger Brown

Chairman, Dept. of Chemical and Metallurgical Enginering, U. of Michigan

Condensate, the new liquid product being produced from natural gas in high-pressure recycling plants can yield a motor fuel suitable for sale directly to the ultimate consumer. It need not be sold as a blending agent.

Condensate is secured in much the same manner as natural gasoline, but has a wider boiling range. Because of this it can be fractionated as desired to secure finished motor fuels of satisfactory volatility without blending.

These motor fuels, either standard or premium grade, meet the new federal specifications and are competitive with fuels now sold in certain areas of the country. In addition, they are low in sulfur, free from gum, and have good lead susceptibility.

EVERY industry or company is in a stronger position when producing and marketing a product suitable for use by the ultimate consumer than when producing a product that requires further processing or blending by some other operator before reaching the ultimate consumer.

This principle was recognized and applied in the natural gasoline industry about 20 years ago with most successful results by at least one member of the Association. In that case a finished superior motor fuel based on natural gasoline was sold to the consuming public, instead of selling natural gasoline (a "casing head", as it was then called) to refiners for blending. The success of this program is now a matter of history.

Now a new product, condensate, is being produced from natural gas in much the same manner as is natural gasoline. The condensate has a wider boiling range and therefore offers more opportunity for diverse products such as motor fuel and kerosene than does natural gasoline. Where it is usually necessary to blend some other material with natural gasoline to produce a finished motor fuel of satisfactory volatility, this is not necessary in the case of condensate. In either case suitable fractionation is required, but such equipment is now generally available.

The purpose of this discussion is to consider the production of a superior motor fuel from condensate suitable for distribution to the ultimate consumer.

This would appear to be dependent upon the production of a product of satisfactory octane number, as all other requirements can be met easily by proper fractionation or distillation of the condensate to obtain the desired volatility and vapor pressure.

The character of motor fuel marketed in Chicago and Texas during the falls of 1942 and 1944 as reported in the Bureau of Mines Surveys, the results of a private 1945 survey of midwest motor fuels, the most volatile fuel in the 1945 survey, and the new federal specifications for motor fuel are all compared in the following tables with four motor fuels prepared from condensate.

Inspection of Table 1 indicates that the four condensate motor fuel samples have no difficulty meeting the Federal Specifications for standard grade motor fuel, as well as the competition of the winter fuels of 1942 or 1944. Also, the lead tetraethyl required to bring these condensate motor fuels up to 74 octane is no greater than that required for the average motor fuel sold in the midwest area. They are not so volatile, however, as the most volatile fuel marketed last fall.

Some care must be used in regard to meeting maximum vapor pressure specifications for grades A and B. But this should offer no difficulty, as condensate or recycle plants are usually well equipped with fractionating equipment capable of recovering isobutane, and the front end volatility of the fuel can be

TABLE 1—Comparison of Standard Grade Motor Fuels

	°API	ASTM Octane	cc TEL	10% over	50% over	90% over	V.P.	% S
1. Average Chicago, 1942	65.7	72.3	.	116	211	325	11.5	0.071
2. Average Texas, 1942	62.3	73.2	.	125	231	331	9.7	0.063
3. Average Chicago, 1944	62.1	70.2	...	121	238	347	10.8	0.061
4. Average Texas, 1944	58.6	70.5	.	135	252	352	8.1	0.128
5. Average Midwest Fall, 1945	62	74.5	1.5	128	227	339	9.2	0.057
6 Midwest Extreme, 1945	67.5	77.2	2.6	116	178	324	11.0	0.044
7. Condensate G 91940	67.9	73.6	0.5	120	206	328	12.0	.
8. Condensate G 7341	64.9	74.2	1.0	137	223	340	10.0	.
9. Condensate W1	66.8	..	.	134	204	318	7.7	..
10. Condensate CV	70.0	74.7	1.0	120	202	338	10.0	0.026
11. Fed. Spec. A, 1946	..	74	3.0	158	266	365	9.0	0.10
12. Fed. Spec. B, 1946	.	74	3.0	140	257	365	11.0	0.10
13. Fed. Spec. C, 1946	..	74	3.0	131	248	356	13.0	0.10

TABLE 2—Comparison of Premium Grade Motor Fuels

	°API	ASTM Octane	cc TEL	10% over	50% over	90% over	V.P.	% S
1. Average Chicago, 1942	66.1	79.1	..	115	205	315	11.5	0.069
2. Average Texas, 1942	63.3	78.9	.	128	220	315	9.3	0.041
3. Average Chicago, 1944	61.6	75.1	..	119	233	346	10.7	0.083
4. Average Texas, 1944	59.5	75.3	..	132	248	346	8.3	0.107
5. Average Midwest Fall, 1945	61.9	79.3	2.4	129	223	332	9.1	0.051
6. Midwest Extreme, 1945	64.4	81.2	3.0	116	195	305	11.6	0.039
7. Condensate G 91940	67.9	82.2	1.5	120	206	328	12.0	....
8. Condensate G 7341	64.9	82.8	3.0	137	223	340	10.0	..
9. Condensate LSG	73.4	86	.	112	122	280	10.5	....
10. Condensate CV	70	82.3	3.0	120	202	338	10.0	0.026
11. Fed. Spec. A, 1946	....	80	3.0	158	257	356	9.0	0.10
12. Fed. Spec. B, 1946	....	80	3.0	140	239	356	11.0	0.10
13. Fed. Spec. C, 1946	....	80	3.0	131	230	338	13.0	0.10

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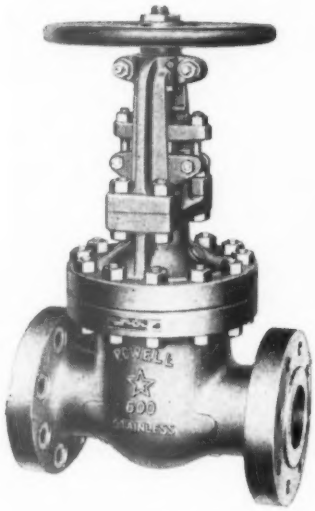
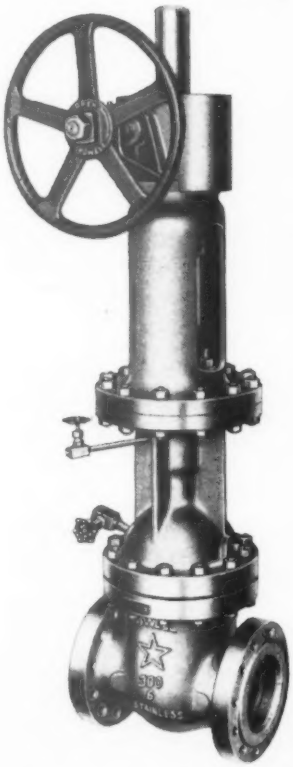
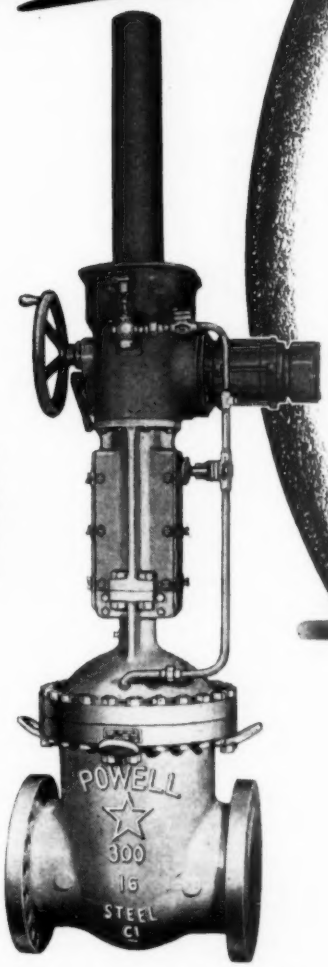


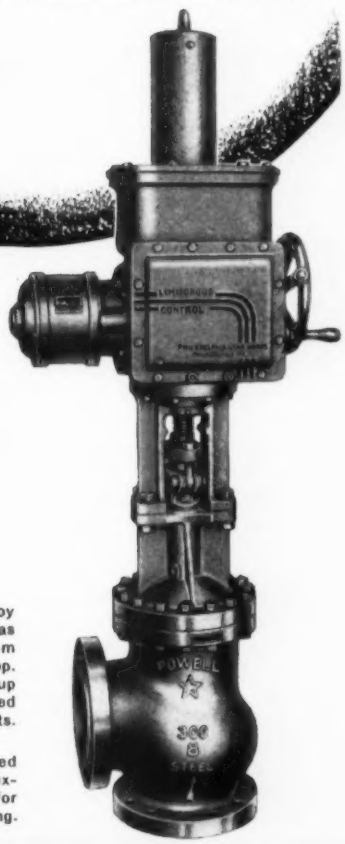




(Above) Class 300-pound Cast Alloy Steel Gate Valve. Designed for refineries producing 100 octain aviation gasoline. Has automatic steam sealing mechanism and top-mounted, fully enclosed, explosion proof electric motor operator for quick, positive opening and closing.

(Upper Left) Class 600-pound Stainless Steel O. S. & Y. Gate Valve. Specially adapted for extremely high (up to 1400F) or low (to - 300 F) temperatures.

(Lower Left) Class 300-pound Cast Alloy Steel Gate Valve. Designed to withstand the ultra high temperatures encountered in T. C. C. It has cooling fins to dissipate the heat, thereby reducing temperature in the stuffing box. Bevel gear operated. Spur gear operation, if desired.



(Above) Class 300-pound Cast Alloy Steel Angle Valve. Streamlined areas through the body assure maximum flow with minimum pressure drop. Built to handle high temperatures (up to 1400F) such as are encountered in transfer lines in T. C. C. plants.

(Right) Same valve as above equipped with top-mounted, fully enclosed, explosion proof electric motor operator for quick, positive opening and closing.

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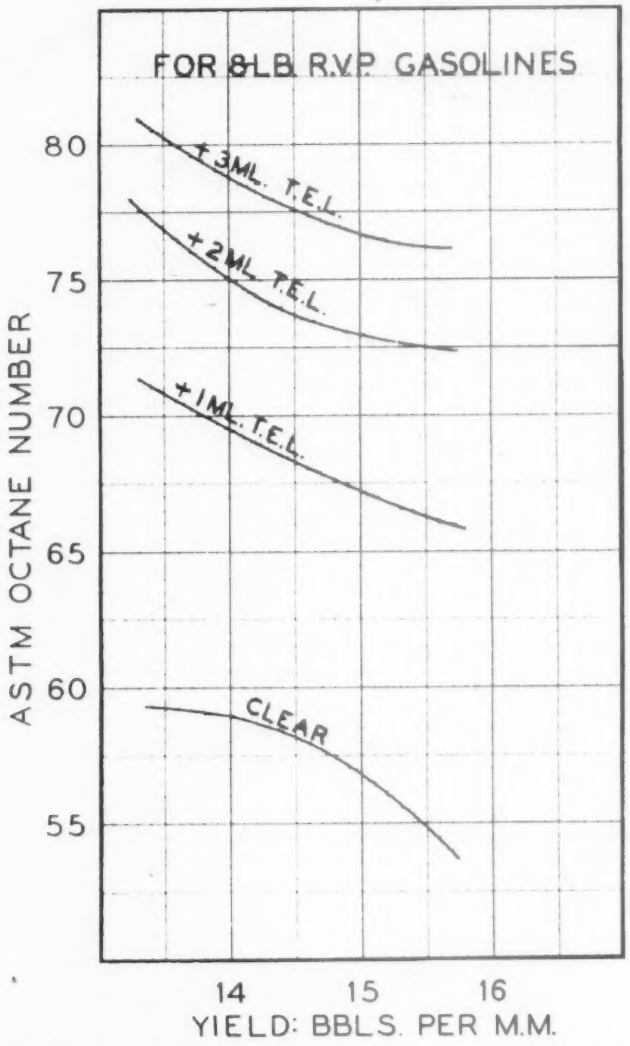


Fig. 1—Typical data showing the effect of vapor pressure upon the yield and octane rating of liquid condensate from natural gas

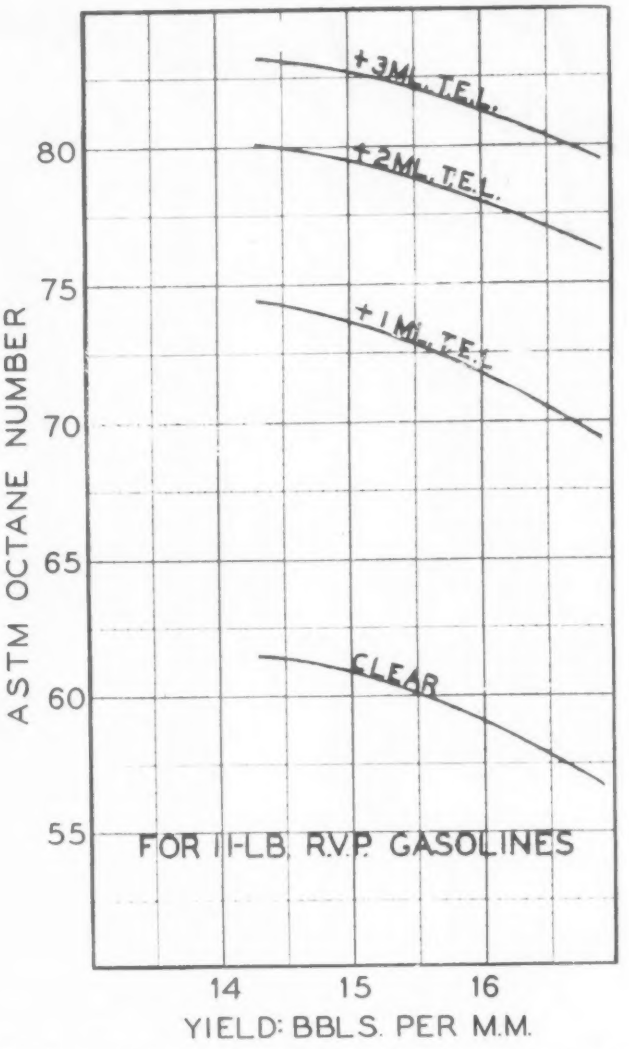


Fig. 2—Typical data showing the effect of vapor pressure upon the yield and octane rating of liquid condensate from natural gas

adjusted for any reasonable vapor pressure.

Comparison of the data in Table 2 leads to about the same conclusions regarding premium grade motor fuel. However, one of the condensate motor fuel samples, L.S.G., is much more volatile than the most volatile motor fuel marketed last fall in the midwest area, either standard or premium grade. It meets the volatility requirements for aviation fuel. This clearly indicates that fuels of the maximum volatility and meeting all specifications may be produced from condensate as readily as from any refining operation, a fact thoroughly appreciated by anyone familiar with these operations.

All other specifications, such as maximum of 2% residue upon ASTM distillation, 4 mg. gum per 100 ml., 4 hrs. stability in oxygen bomb and negative corrosion, are readily met by condensate products.

The yield of motor fuel of any particular character from condensate wells depends upon the quality and quantity of the liquid condensate. The curves of Figs. 1 and 2 are directly applicable only to that particular gas from which the data were obtained. They are given here simply to indicate the influence of end point and vapor pressure upon yield and octane number.

From the data available it appears that 74 octane number can be attained with a moderate addition of lead to any condensate motor fuel, and that 80 octane number can be attained without exceeding the maximum of 3 ml. of TEL. The susceptibility of condensate to TEL is indicated in Table 3.

TABLE 3—Lead Susceptibility of Three Condensate Motor Fuels

TEL	Sample G 91940	Sample G 7341	Sample C.V.
Clear	.....	.....	61.5 (63)
+0.5	73.6	.....	.....
+1.0	79.1 (78.1)	74.3 (73.1)	74.7 (73.2)
+1.5	82.2	.....	.....
+2.0	83.6	80.0 (79.3)	.....
+2.5	.....	.....	.....
+3.0	.....	82.8 (82.4)	82.3 (82.1)

Conclusions

A motor fuel of either standard grade (74 ASTM octane number) or premium grade (80 octane) can be produced from condensate wells. It can meet all the requirements of the new federal motor fuel specifications or all the competitive qualities of any motor fuel sold in these grades in the midwest area. Such a fuel is likely to be unusually low in sulphur and free from gum. It is entirely satisfactory for distribution as motor fuel to the ultimate consumer and need not be sold as a blending agent.

Acknowledgment

The cooperation of C. R. Williams of the Chicago Corp., M. R. Lents of the Cotton Valley Operators Committee and A. F. Garrett of the Lone Star Producing Co. in supplying suggestions and data is gratefully acknowledged.

Principles of Reactor Design

Article No. 2 (cont.)
PYROLYSIS OF PROPANE

By P. S. Myers and K. M. Watson

University of Wisconsin, Madison

Rate equations were developed in the first half of this article (NPN Technical Section, May 1, 1946, pg. R-388) for ten reactions which contribute significantly in determining the rate and product distribution in propane pyrolysis operations. The authors discussed how, by simultaneous integration of these ten equations, the results to be obtained in any specified reactor arrangement could be predicted. This month they demonstrate the procedure developed by applying it in the design study of a commercial-scale plant and predicting temperature gradients and pressure drop.

Illustrative Design Problem

In order to demonstrate the use of individual rate equations in a reactor design study the following problem is analyzed and a solution developed:

It is desired to design a direct-fired tubular reactor for the pyrolysis of 1000 bbl. (42 gal. @ 60° F.) per operating day of liquid propane with a conversion of 85% at a maximum temperature which is limited by the available tube materials to 1400° F. In order to minimize the loss of ethylene at elevated pressures it is desired that the gage pressure at the reactor outlet shall be 5-15 psi. The propane feed is available from a vaporizer and preheater at a temperature of 500° F. and a gage pressure of 55-65 psi.

An engineering study is to be based on a direct-fired type of reactor in which the propane passes progressively through a series of tubes heated at a rate of 8000 Btu/(hr.) (sq. ft.), based on internal area, until its temperature reaches 1400° F. The reaction is completed, if necessary, in additional tubes in which the heat input rate is controlled by shielding the tubes or by regulating the firing to maintain a constant temperature of 1400° F. The tubes are to be 30 ft. long and provided with 180° return bend fittings so arranged that only 28 ft. of the tube is in the heated portion of the furnace. Tube sizes ranging from 1 in. I.D. upward in steps of ½ in. I.D. are available. The design of the return bends is such that the volume of each is equal to $3.1D^3$ and its pressure drop is equivalent to a straight tube of length equal to $60D$.

It is desired to determine the proper tube diameter to conform to these pressure drop specifications, the number of tubes in both the heating and reactor sections and a complete analysis of the progressive change in temperature, pressure, and composition of the fluid stream as it passes through the tube bank.

Working Charts

To facilitate the calculations involved in the design study outlined above it is desirable to prepare working charts from which heats of reaction, heat capacities and viscosities may be read at any conditions encountered in the analysis. The enthalpy change ΔH or heat of reaction of each of the reactions of Table 1* is plotted as a function of temperature in Fig. 10. These curves are based on data from the literature[4, 5, 7, 10, 13, 15, 16, 18] where available. In the absence of direct data the generalizations of Anderson, Beyer, and Watson[1] were employed.

Because of the large number of components involved in the reactions, consideration of individual heat capacities and vis-

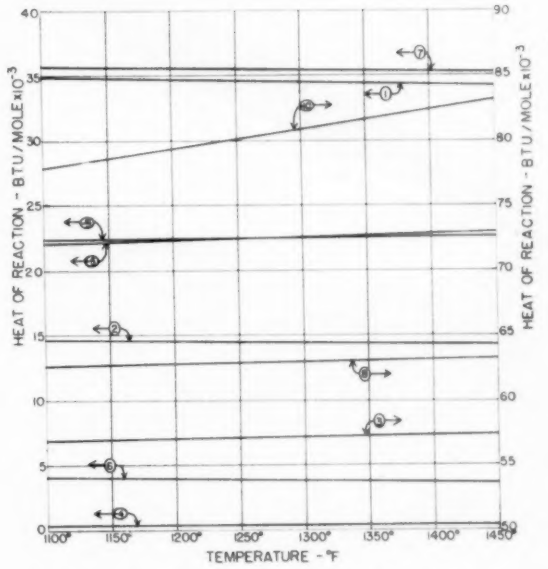


Fig. 10—Standard heats of reaction (numbers refer to Table 1)

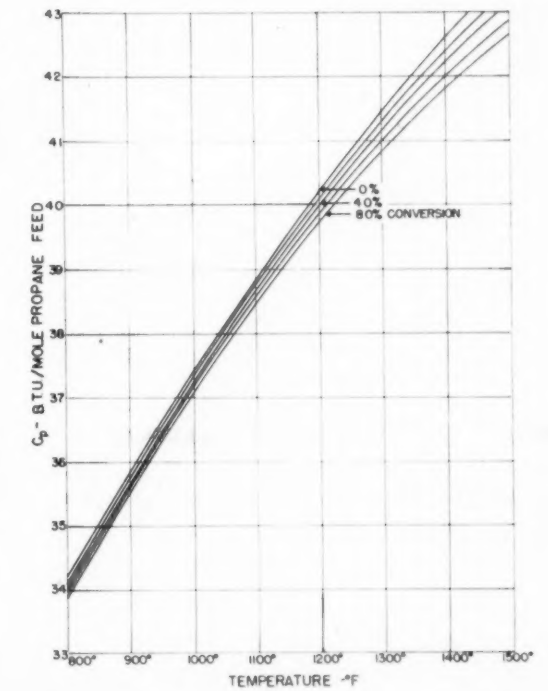
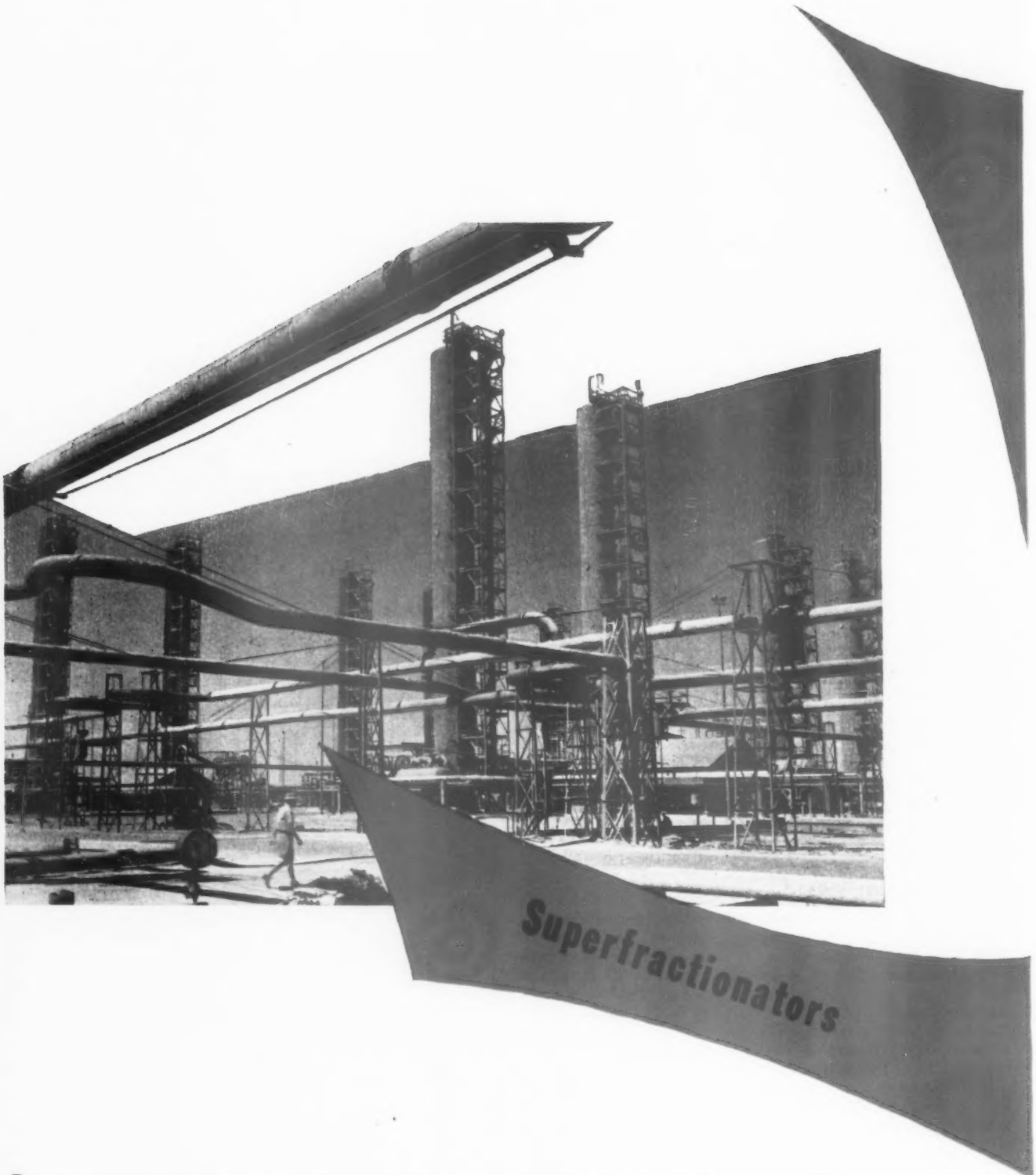


Fig. 11—High temperature heat capacities

* Figs. 1 through 9 and Table 1 appear in the first half of this article, NPN Technical Section, May 1, 1946, pgs. R-388-396.



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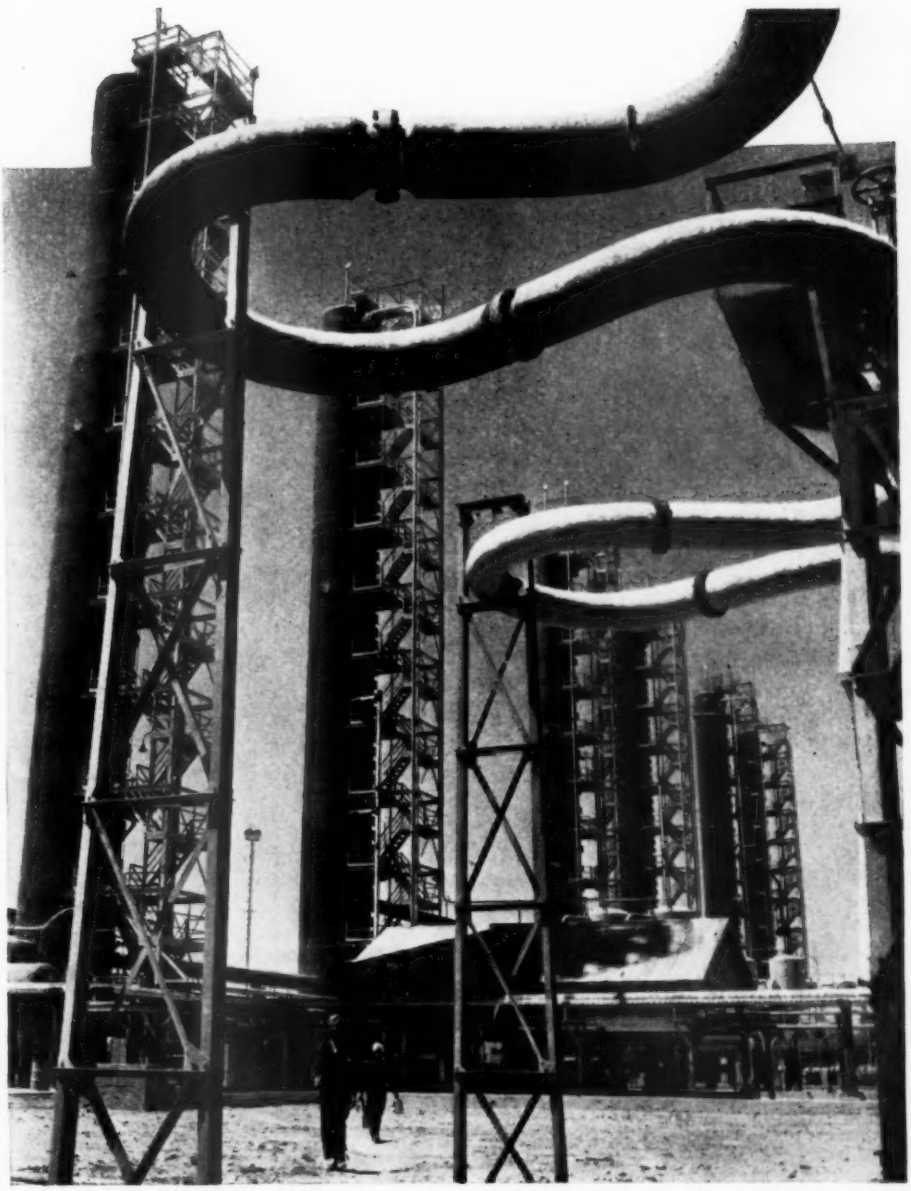

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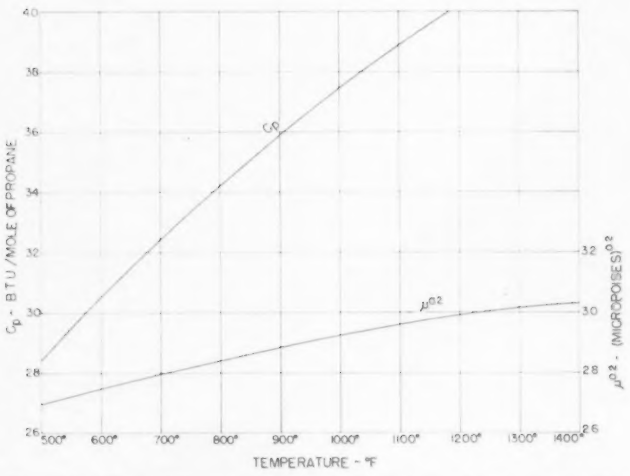

Fig. 12—Viscosities and low temperature heat capacities

cosities would be very tedious. Since the heat capacity of a fixed *mass* of hydrocarbons is affected relatively little by changes in composition resulting from reaction it is satisfactory to plot a family of general curves expressing the heat capacity of the process stream per mole of propane fed as a function of temperature and conversion. The product distributions of Figs. 1 and 2 were assumed for these calculations and the resultant curves are plotted in Fig. 11. It will be noted that since conversion has relatively little effect, deviation from the assumed product distributions will produce errors which are negligible in comparison to other assumptions, such as the constancy of heat input rate.

Similarly, the viscosity of the reaction mixture does not vary greatly with conversion and since it enters into the pressure-drop calculations with an exponent of only 0.2 it may also be handled by general curves assuming a typical product distribution. Such curves relating $(\mu)^{0.2}$ to temperature are plotted in Fig. 12. It was found that conversion had a negligible effect on this relationship. The viscosities were calculated from the product distributions of Figs. 1 and 2 using the generalized correlation of Uyehara and Watson[20].

Selection of Tube Size

The selection of the proper tube size for the reactor is largely determined by the permissible pressure drop, which may be calculated from the following restricted form of the Fanning equation suggested by McAdams[11] for gases at high Reynolds numbers.

$$\frac{dp}{dL} = \frac{.0235}{D^{4.8}} \left(\frac{w}{1000} \right)^{1.8} \frac{(\mu)^{0.2}}{\rho} \qquad (13)$$

where

dp/dL = pressure drop in psi per foot of tube length,
D = inside diameter, inches,
w = mass rate of flow, lb./hr.,
μ = viscosity, micropoises,
ρ = density, lb./cu. ft.

The tube diameter corresponding to the specified pressure drop is dependent upon the total equivalent length of the tube bank, which in turn is determined by the surface required to heat the feed to reaction temperatures and by the volume required for the completion of the reaction. Thus, for any assumed tube size a definite number of tubes will correspond to the specified pressure drop, another number of tubes is required to supply the required heat transfer at the specified rate and a third number of tubes is required to provide sufficient volume for the completion of the reaction. With the correct tube diameter these three numbers of tubes are equal and correspond to the number of tubes actually required for the overall duty.

Preliminary overall pressure-drop calculations for the selection of tube size are based on an average temperature of 950° F., an average absolute pressure of 45 psi and an average conversion of 42.5% with the corresponding product distribution of Figs. 1 and 2. On the basis of these assumptions the average reactant stream comprises 1.385 moles per mole of propane charged. From Fig. 12 the value of $(\mu)^{.2}$ is read as 2.9. The density at the average conditions is calculated as .0945 lb./cu. ft. The specified feed rate is 7455 lb./hr. or 169.4 (lb.-moles)/(hr.) of propane. Substituting these values in Equation 13 an expression is obtained for the average pressure drop per tube.

$$\Delta P = 27 \frac{L}{D^{4.8}} = \frac{27(30+5D)}{D^{4.8}} \qquad (14)$$

where L = total equivalent length per tube in feet, = 30 + 5D.

The number of tubes permitted by a specified pressure drop of 50 psi is then given by

$$N_p = \frac{50\ D^{4.8}}{27(30+5D)} = \frac{0.37\ D^{4.8}}{6+D} \qquad (15)$$

The number of tubes required for the specified heating duty is based on the preliminary assumption that reaction is completed when the maximum temperature of 1400° F. is reached. From the data of Fig. 10 the approximate heat of reaction for an 85% conversion with the product distribution of Figs. 1 and 2 is 37,400 Btu/(lb.-mole propane converted). From Fig. 11 the average heat capacity of the process stream is 36.5 Btu/(° F.) (lb.-mole propane charged). On this basis the total heating duty of the furnace is approximately 169.43 [36.5(1400-500)+(37,400)(.85)] = 11.0×10^6 Btu/hr. If all of this heat is absorbed in the heating section of the furnace at the specified rate of 8000 Btu/(hr.)(sq. ft.), a total internal heating area of 1370 sq. ft. is required. The number of tubes required for the heating duty is then expressed by

$$N_h = \frac{1370}{(28)(\pi)(D/12)} = \frac{187}{D} \qquad (16)$$

In Table 2 are summarized the numbers of tubes calculated from Equations 15 and 16 for a series of tube diameters.

TABLE 2—Preliminary Selection of Tube Size

D	$(D)^{4.8}$	$(6+D)$	N_p	N_h
3	195	9	8	62
3.5	410	9.5	16	53
4.0	780	10.0	29	47
4.5	1360	10.5	48	42
5.0	2250	11.0	76	37
5.5	3600	11.5	116	34

Comparison of the last two columns of Table 2 shows that at any tube diameter below 4.5 in. the permissible pressure drop would be exceeded before the number of tubes required for heating are provided. With a 4.5 inch diameter only 42 tubes are required for heating while 48 are permissible for the pressure drop. This leaves a margin of 6 tubes for the reactor section if the desired conversion is not reached in the heating section. Since pressure drop varies so greatly with tube diameter it is probable that the proper diameter is either 4.5 or 5.0 inches. In order to maintain as high a mass velocity as possible to improve heat transfer the smaller tube is a desirable choice for further investigation.

Simplified Reactor Integration

In order to verify the preliminary choice of tube diameter and arrive at an improved estimate of the number of tubes required it is desirable to carry out a simplified kinetic analysis of the conditions in the tube bank. Such a simplified integration yields with little effort good approximations to the simultaneous variation of conversion, temperature and pressure throughout the reactor but does not resolve the conversion into complete product distributions. The results of a simpli-

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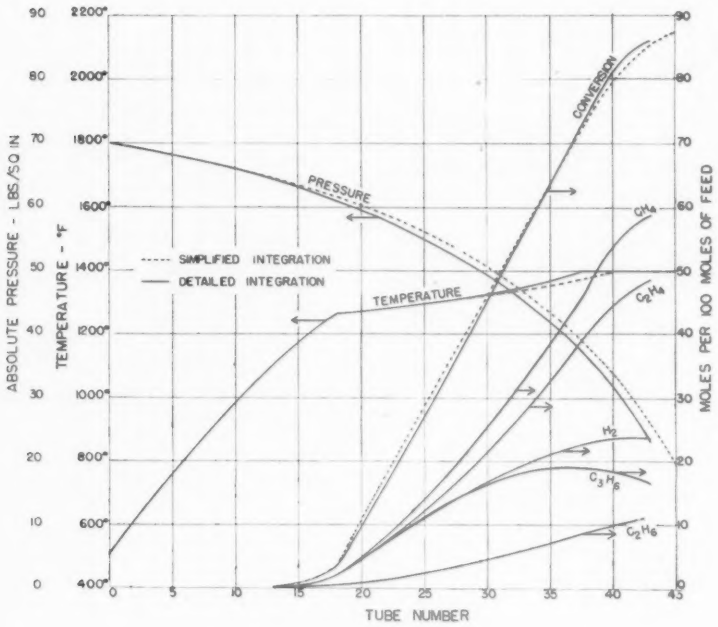

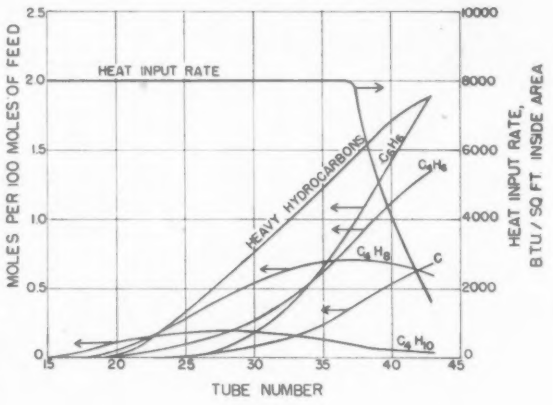

Fig. 13 (left) and Fig. 14 (above)—Integrated reactor conditions

fied analysis may serve to reject inoperable arrangements or poor choices of initial specifications without the necessity of a detailed analysis. The simplified analysis also serves as a guide which expedites the more complex study.

The following simplifying assumptions are made:

1. Propane is decomposed only by the primary reactions 1-4 of Table 1, and all other reactions, including the reversals of the primary reactions, are negligible in their effect on overall conversion-temperature-pressure relationships. The effective reaction velocity constant of the combined reactions is indicated by the summation of the curves marked (1), (2), (3), (4) in Fig. 6.

2. The average total number of moles of products from the decomposition of one mole of propane is taken as 1.91, corresponding to the product distribution of Figs. 1 and 2 at 42.5% conversion.

3. The average heat of reaction is the 37,400 Btu/(lb.-mole propane converted) used in the preliminary selection of tube diameter.

4. Deviations from the ideal gas law are negligible.

The kinetic analysis of the reactor may be started from either the inlet or the outlet. If the outlet pressure is specified, as is usually the case, starting from the inlet requires assumption of an inlet pressure. If the corresponding outlet pressure calculated from the analysis does not fall in the specified range the analysis must be repeated with a corrected inlet pressure. If the integration is started from the outlet a similar uncertainty exists as to the number of tubes required in the reactor section as distinct from the heating section. This problem can be handled by assuming the size of the reactor section and completing the analysis to the inlet. If the calculated conversion is not zero at the inlet the analysis is repeated with a corrected reactor section size. There is frequently little to choose between these two approaches. In this case the integration is started from the inlet with an assumed absolute pressure of 70 psi.

The calculations of the integration are summarized in Table 3. The reactor is considered as divided into sections, each comprising 2 to 5 tubes. Starting from the inlet, trial values of the average temperature, pressure, and conversion in the first section are estimated. The conversion occurring in the section is then calculated from Equation 12 and the pressure

TABLE 3—Simplified Reactor Analysis

	Tube Numbers	1-5	6-10	11-13	14-18	19-23	24-28	29-33	34-38	39-40	41-45
1.	Number of Tubes	5	5	3	5	5	5	5	5	2	5
2.	Est. Ave. Temp., °F.	625	860	1035	1175	1275	1295	1330	1362	1388	1400
	°R.	1080	1320	1495	1635	1735	1755	1790	1822	1848	1860
3.	Est. Ave., Conversion %	0	0	0	1.5	12.0	29.0	48.0	65.0	77	83.5
4.	(1—[3])/100	1.0	1.0	1.0	.985	.88	.71	.52	.35	.23	.165
5.	.91 [3]	0	0	0	.0137	.109	.264	.437	.592	.701	.761
6.	$n_t = 1 + [5]$	1.0	1.0	1.0	1.014	1.11	1.27	1.44	1.59	1.70	1.76
7.	Mol fraction C_3H_8, [4]/[6]	1.0	1.0	1.0	.971	.794	.562	.362	.22	.135	.094
8.	Est. Av. Pres., psi	69.1	67.0	64.9	62.6	60.0	55.5	50.0	42.3	36.2	26.5
	atm.	...	...	...	4.25	4.08	3.78	3.40	2.88	2.46	1.80
9.	Reaction velocity constant (Fig. 6)	...	...	...	.0778	.558	.809	1.36	2.66	4.20	4.79
10.	$\Delta x = .0205$ [1] [7] [8] [9]	...	...	...	.0329	.185	.176	.171	.173	.057	.083
11.	Conversion at outlet	...	...	...	.0329	.218	.394	.565	.738	.795	.878
12.	μ .2 (Fig. 12)	2.76	2.86	2.93	2.98	3.00	3.01	3.02	3.02	3.03	3.03
13.	$\Delta\pi = .00817$ [1] [2] [6] [11]/[8]	1.78	2.48	1.62	3.21	3.92	4.93	6.29	8.48	4.1	14.6
14.	Press. at outlet, π	68.2	65.7	64.1	60.9	57.0	52.1	45.8	37.3	33.2	18.6
15.	C_p (Figs. 11, 12)	31.0	35.2	37.9	39.8	40.8	41.3	41.7	42.1	42.6	
16.	Heat Input [1] × 1558	7790	7790	4680	7790	7790	7790	7790	7790	3116	[c]3190
17.	$\Delta H_r = [10] \times 37{,}400$	0	0	0	1230	6930	6580	6400	6470	2140	3100
18.	[16] — [17]	7790	7790	4680	6560	860	1210	1390	1320	976	0
19.	$\Delta t = [18]/[15]$	251	222	123	165	21	29	33	31	23	0
20.	t at outlet, °F.	751	973	1096	1261	1282	1311	1344	1375	1398	1400

[c]Calculated from ΔH_r since this is the reactor section.

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TABLE 4—DETAILED REACTOR ANALYSIS

BASIS: 1 Hour of Operation, Feeding 169.4 Lb.-Moles of Propane

1. Tube Numbers (Inclusive)		14-16	17-19	20-22	23-25	26-28	29-31	32-34	35-37	38-40	41-43
2. Number of Tubes		3	3	3	3	3	3	3	3	3	3
3. Average Temperature	°F	1143	1230	1270	1285	1303	1322	1347	1372	1400	1400
	°R	1603	1690	1730	1745	1763	1782	1807	1832	1860	1860
4. Average Absolute Pressure	Lb/sq. in.	63.2	61.25	59.1	56.4	53.5	49.8	45.9	41.2	35.0	27.4
	atm.	4.30	4.17	4.02	3.84	3.64	3.39	3.12	2.80	2.38	1.87
CONVERSION CALCULATIONS											
5. Estimated Total Moles, n_t		170	175	186	203	220	236	252	270	288	299
6. n_t^2		29,200	30,600	34,600	41,200	48,200	55,700	63,500	72,900	82,700	89,400
7. Estimated Average Moles, H_2		.4	2.8	8.6	15.3	21.4	26.9	31.6	35.5	38.4	39.9
8. Estimated Average Moles, C_2H_4		.3	2.4	8.7	16.5	24.6	34.4	44.7	57.0	69.4	78.8
9. Estimated Average Moles, C_2H_6		.06	.44	1.47	3.03	4.85	7.26	9.47	12.58	15.46	17.77
10. Estimated Average Moles, C_3H_6		.4	3.0	9.1	15.9	21.5	26.3	29.7	32.3	31.7	29.5
11. Estimated Average Moles, C_3H_8		168	160	150	134	115	97.1	78.8	58.9	40.4	27.3
12. Estimated Average Moles, C_4H_8		.01	.03	.18	.36	.63	.86	1.05	1.16	1.07	1.04
13. Estimated Average Moles, C_4H_{10}		.02	.09	.22	.29	.32	.29	.24	.17	.13	.07
14. Estimated Average Moles, $C_2H_6 + C_3H_8 + C_4H_{10}$				.31	.36	.78	1.20	1.65	2.22	2.65	3.07
15. $\Delta V/F = [2] \times 3.475$		10.4	10.4	10.4	10.4	10.4	10.4	10.4	10.4	10.4	10.4
Incremental Conversion from Reaction No. 1 = $k\pi\ nC_3H_8/n_t\ \Delta V/F$											
16. Reaction Velocity Constant k (Fig. 6)		.014	.094	.22	.28	.40	.57	.92	1.45	2.38	2.38
17. Inc. Conv. = [4] [11] [15] [16]/[5]		.60	3.75	7.44	7.45	7.98	8.29	9.37	9.22	8.27	4.22
Incremental Conversion from Reaction No. 2 = $k\pi\ nC_3H_8/n_t\ \Delta V/F$											
18. Reaction Velocity Constant k (Fig. 6)		.004	.027	.060	.077	.111	.152	.247	.388	.61	.61
19. Inc. Conv. = [4] [11] [15] [18]/[5]		.18	1.08	2.03	2.04	2.22	2.25	2.52	2.47	2.12	1.08
Incremental Conversion from Reaction No. 3 = $k\pi\ \Delta V/F\ [nC_3H_8/n_t - (nC_2H_6\ nH_2\pi)/n_t^2K]$											
20. Reaction Velocity Constant k (Fig. 6)		.018	.104	.22	.272	.38	.51	.79	1.20	1.85	1.85
21. Equilibrium Constant K (Fig. 7)			1.27	1.92	2.13	2.58	2.95	3.50	4.30	5.10	5.10
22. $nC_2H_6\ nH_2\pi/n_t^2K = [4]\ [7]\ [10]/[6]\ [21]$			.00089	.00476	.0106	.0134	.0146	.0132	.0103	.0069	.0048
23. nC_2H_6/n_t = [11]/[5]		.99	.917	.817	.657	.525	.411	.313	.218	.141	.091
24. [23] — [22]		.99	.916	.812	.646	.512	.397	.300	.208	.134	.087
25. Inc. Conv. = [4] [15] [20] [24]		.81	4.15	7.48	7.07	7.38	7.15	7.70	7.29	6.15	3.11
Incremental Conversion from Reaction No. 4 = $k\ \pi\ \Delta V/F\ [nC_3H_8/n_t - \sqrt{nC_2H_6\ nC_4H_{10}}/n_t^2K]$											
26. Reaction Velocity Constant k (Fig. 6)		.00135	.0067	.013	.016	.021	.028	.042	.061	.092	.092
27. Equilibrium Constant K (Fig. 7)			1.31	1.305	1.30	1.30	1.30	1.295	1.29	1.285	1.285
28. $nC_2H_6nC_4H_{10}/n_t^2K$ = [9] [13]/[6] [27]			.00000097	.000007	.0000164	.0000244	.0000291	.0000278	.0000228	.0000189	.0000104
29. $\sqrt{[28]}$			.00099	.0027	.004	.0049	.0054	.0053	.0048	.0044	.0032
30. [23] — [29]		.99	.916	.814	.653	.520	.406	.308	.218	.136	.088
31. Inc. Conv. = [4] [15] [26] [30]		.06	.27	.44	.42	.42	.40	.42	.39	.31	.16
Incremental Conversion from Reaction No. 5 = $k\pi\ \Delta V/F\ nC_3H_6\ n_t$											
32. Reaction Velocity Constant k (Fig. 6)		.024	.074	.122	.138	.171	.203	.273	.355	.47	.47
33. Inc. Conv. = [4] [10] [15] [32]/[5]		.00279	.0548	.25	.43	.63	.79	1.05	1.25	1.29	.91
Incremental Conversion from Reaction No. 6 = $k\pi\ \Delta V/F\ nC_3H_6/n_t$											
34. Reaction Velocity Constant k (Fig. 6)		.049	.25	.50	.61	.83	1.10	1.68	2.45	3.75	3.75
35. Inc. Conv. = [4] [10] [15] [34]/[5]		.0057	.1854	1.025	1.91	3.07	4.33	6.45	8.95	10.25	7.29
Incremental Conversion from Reaction No. 7 = $k\pi\ \Delta V/F\ nC_4H_{10}/n_t$											
36. Reaction Velocity Constant k (Fig. 6)		.16	.98	2.20	2.78	3.90	5.40	8.70	13.30	21.00	21.00
37. Inc. Conv. = [4] [13] [15] [36]/[5]		.0006	.022	.107	.159	.213	.285	.272	.245	.236	.086
Incremental Conversion from Reaction No. 8 = $k\pi\ \Delta V/F\ [nC_2H_6/n_t - nC_2H_4\ nH_2\pi/n_t^2K]$											
38. Reaction Velocity Constant k (Fig. 6)		.0033	.0212	.046	.058	.084	.115	.18	.28	.44	.44
39. Equilibrium Constant K (Fig. 7)			.115	.178	.20	.245	.289	.35	.45	.54	.54
40. $nC_2H_4\ nH_2\pi/n_t^2K$ = [4] [7] [8]/[6] [39]			.0078	.0491	.117	.163	.195	.198	.173	.142	.122
41. nC_2H_6/n_t = [9]/[5]		.00035	.00252	.0079	.0149	.0221	.0308	.0374	.0466	.0537	.0594
42. [41] — [40]		.00035	.00532	.0412	.1021	.149	.164	.161	.126	.0885	.062
43. Inc. Conv. = [4] [15] [38] [42]		.000052	.0048	.0793	.237	.448	.668	.942	1.032	.967	.532
Incremental Conversion from Reaction No. 9 = $k\pi\ \Delta V/F\ nC_4H_8/n_t$											
44. Reaction Velocity Constant k (Fig. 6)			1.13	2.70	3.45	5.00	7.00	11.20	18.00	29.5	29.5
45. Inc. Conv. = [4] [12] [15] [44]/[5]			.0008	.1068	.244	.545	.899	1.512	2.255	2.725	1.995
Incremental Conversion from Reaction No. 10 = $k\ \Delta V/F\ [\pi(nC_6H_{10} + nC_2H_2 + nC_3H_8)/n_t]^3$											
46. Reaction Velocity Constant k (Fig. 6)			66	105	116	140	170	220	275	355	355
47. [4] [14] /[5]			.00006	.00657	.00685	.01288	.01728	.0205	.0231	.0219	.0191
48. Inc. Conv. = [15] [46] [47]			.000002	.0473	.0568	.242	.529	.964	1.522	1.775	1.355
Incremental Production of Indicated Product from Indicated Reaction											
49. No. 2, C_2H_6, C_3H_6, CH_4, [19]/2		.0899	.539	1.020	1.018	1.111	1.125	1.260	1.235	1.060	.542
50. No. 4, C_2H_6, C_4H_{10}, [31]/2		.03	.134	.222	.209	.208	.202	.211	.195	.153	.079
51. No. 6, CH_4, .149 [35]		.00085	.0276	.1527	.2846	.4574	.6482	.9611	1.3336	1.5273	1.0860
52. No. 6, $(C_2H_6 + C_3H_8 + C_6H_{10})$, .2235 [35]		.00127	.0414	.2291	.4269	.6861	.9722	1.4416	2.00	2.291	1.629
53. No. 6, C_2H_4, C_3H_6, .2555 [35]		.00145	.0474	.2619	.488	.784	1.111	1.648	2.287	2.619	1.863
54. No. 6, H_2, .0745 [35]		.00042	.0138	.0764	.142	.229	.324	.481	.667	.764	.545
55. No. 6, C_2H_6, C_4H_8, .053 [35]		.0003	.0098	.054	.101	.163	.231	.342	.474	.543	.386
56. No. 7, H_2, C_4H_8, .12 [37]		.000076	.00263	.0128	.0191	.0255	.0282	.0326	.0294	.0283	.0103
57. No. 7, CH_4, C_3H_6, .49 [37]		.00031	.01073	.0524	.0779	.1041	.1152	.1333	.1201	.1154	.042
58. No. 7, C_2H_4, .39 [37]		.00025	.00854	.0570	.0620	.0829	.0917	.1061	.0956	.0918	.0334
59. No. 7, C_2H_6, .38 [37]		.00024	.00830	.0437	.0603	.0806	.0892	.1032	.0930	.0893	.0325

54.	No. 6, H	.0745 [35]	00145	.0474	.2619	.488	.784	1.111	1.648	2.287	2.619	1.863
			00042	.0138	.0763	.142	.229	.324	.481	.667	.764	.543
55.	No. 6, C_2H_6, C_4H_8, .053 [35]		.0003	.0098	.054	.101	.163	.231	.342	.474	.543	.386
56.	No. 7, H_2, CH_4, .12 [37]		.000076	.00263	.0128	.0191	.0255	.0282	.0326	.0294	.0283	.0103
57.	No. 7, CH_4, C_2H_6, .49 [37]		.00031	.01073	.0524	.0779	.1041	.1152	.1333	.1201	.1154	.042
58.	No. 7, C_2H_4, .39 [37]		.00025	.00854	.0570	.0620	.0829	.0917	.1061	.0956	.0918	.0334
59.	No. 7, C_2H_6, .38 [37]		.00024	.00832	.0407	.0604	.0808	.0893	.1034	.0931	.0895	.0326
60.	No. 7, C_3H_8, .01 [37]		....	.	.00107	.0016	.00213	.00235	.00272	.00245	.00236	.0009
61.	No. 10, C_6H_6, .472 [48]		....	.0000011	.0223	.0268	.1142	.2497	.455	.7184	.8378	.6396
62.	No. 10, CH_4, .91 [48]		....	.0000022	.0430	.0517	.220	.481	.877	1.385	1.615	1.233
63.	No. 10, C_2H_4, .333 [48]		....	....	.0185	.0189	.0806	.1762	.321	.507	.591	.451
64.	No. 10, C, .178 [48]		....	....	.0084	.0101	.0431	.0942	.1716	.271	.316	.241
	Net Production of Indicated Product											
65.	H_2, [25] — [33] — [43] — [45] + [54] + [56]		.805	4.11	7.13	6.32	6.01	5.15	4.71	3.45	1.96	.223
66.	C, [64]		.	.00000043	.00842	.0101	.0431	.0942	.1716	.271	.316	.241
67.	CH_4, [17] + [33] + [45] + [49] + [51] + [57]		.692	4.38	9.02	9.51	10.82	11.87	14.28	15.41	14.98	8.80
68.	(C_2H_2 + C_3H_8 + C_6H_{10}), [52] — [48]		.00127	.00419	.1818	.370	.444	.443	.478	.478	.516	.274
69.	C_2H_4, [17] + [33] + [53] + [58] + [63] — [43]		.603	3.86	7.95	8.21	9.11	9.79	11.55	12.32	11.89	6.95
70.	C_2H_6, [49] + [50] + [55] + [59] + [43]		.120	.696	1.41	1.63	2.00	2.32	2.86	3.03	2.82	1.57
71.	C_3H_6, [25] + [45] + [49] + [57] — [33] — [35]		.889	4.46	7.38	6.07	5.43	4.15	3.11	.705	—1.49	—2.51
72.	C_3H_8, — [17] — [19] — [25] — [31] + [60]		—1.65	—9.25	—17.39	—17.21	—17.98	—18.09	—20.00	—19.19	—16.85	—8.64
73.	C_4H_6, [55]		.00003	.0098	.0543	.1012	.1627	.2306	.342	.474	.543	.386
74.	C_4H_8, [53] + [56] — [45]		.00153	.0492	16.79	.263	.265	.241	.1686	.061	—.0778	—.1225
75.	C_4H_{10}, [50] — [37]		.0294	.1116	.1145	.050	.005	—.033	—.0615	—.0505	—.0825	—.0069
76.	C_6H_6, [61]		.	.00000114	.0223	.0268	.1142	.250	.455	.718	.838	.640
	Composition of Gases at Outlet of Reactor Section											
77.	H_2, Σ [65]		.805	4.91	12.04	18.36	24.37	29.52	34.23	37.69	39.65	39.88
78.	C, Σ [66]		.	.00000043	.00842	.0185	.0616	.1558	.3274	.5983	.914	1.16
79.	CH_4, Σ [67]		.692	5.08	14.09	23.60	34.42	46.29	60.57	75.98	90.96	99.76
80.	C_2H_2 + C_3H_8 + C_6H_{10}, Σ [68]		.00127	.00542	.187	.557	1.001	1.444	1.992	2.400	2.916	3.190
81.	C_2H_4, Σ [69]		.603	4.46	12.40	20.62	29.73	39.52	51.07	63.39	75.28	82.23
82.	C_2H_6, Σ [70]		.120	.82	2.23	3.85	5.86	8.17	11.03	14.06	16.87	18.44
83.	C_3H_6, Σ [71]		.889	5.35	12.73	18.80	24.23	28.38	31.49	32.19	30.71	28.20
84.	C_3H_8, 169.4 + Σ [72]		167.7	158.5	141.1	123.9	106.00	87.87	67.87	48.68	31.83	23.18
85.	C_4H_6, Σ [73]		.00003	.0102	.0644	.1656	.328	.559	.900	1.375	1.918	2.305
86.	C_4H_8, Σ [74]		.00153	.0507	.219	.482	.747	.987	1.156	1.217	1.139	1.017
87.	C_4H_{10}, Σ [75]		.0294	.141	.256	.306	.306	.272	.211	.160	.079	.071
88.	C_6H_6, Σ [76]		.	.00000114	.0223	.0491	.163	.413	.868	1.586	2.424	3.064
89.	n_t, Σ Items [77] to [88] Inc.		170.9	178.77	195.38	210.74	227.75	244.16	262.31	279.90	294.69	302.49
			PRESSURE DROP CALCULATIONS									
	$\Delta\pi$/tube = .0000482 $T\ n_t u^2/\pi$											
90.	u^2 (from Fig. 12 at [3])		2.98	2.99	3.00	3.01	3.01	3.02	3.03	3.03	3.03	3.03
91.	$\Delta\pi$ = .0000482 [2] [3] [5] [90]/[4]		1.80	2.09	2.36	2.79	3.20	3.70	4.32	5.27	6.70	8.90
92.	Pressure at Outlet of Reactor Section		62.3	60.3	57.9	55.1	51.9	48.2	43.99	38.6	31.91	23.0
			HEAT BALANCE SECTION									
	Heat Input = Σ Hr × Conversion + 169.4 $C_p\ \Delta T$											
93.	Hr, No. 1, Per Mole (Fig. 10)		34,800	34,600	34,600	34,600	34,500	34,500	34,500	34,400	34,400	34,400
94.	Net Hr, No. 1 = [17] [93]		20,800	129,700	257,200	256,700	275,600	286,200	323,200	319,500	284,700	145,300
95.	Hr, No. 2, Per Mole (Fig. 10)		14,600	14,400	14,400	14,400	14,400	14,400	14,400	14,300	14,300	14,300
96.	Net Hr, No. 2 = [19] [95]		2,620	15,600	29,300	29,200	31,800	32,400	36,200	35,400	30,400	15,500
97.	Hr, No. 3, Per Mole (Fig. 10)		56,900	57,200	57,200	57,200	57,200	57,200	57,200	57,300	57,300	57,300
98.	Net Hr, No. 3 = [25] [97]		45,900	237,200	427,700	404,800	422,200	409,100	440,500	417,400	350,300	178,100
99.	Hr, No. 4, Per Mole (Fig. 10)		—270	—305	—310	—310	—310	—320	—320	—320	—330	—330
100.	Net Hr, No. 4 = [31] [99]		—16	—81	—136	—128	—128	—124	—131	—124	—97	—52
101.	Hr, No. 5, Per Mole (Fig. 10)		—21,900	—22,500	—22,600	—22,600	—22,600	—22,700	—22,700	—22,800	—22,800	—22,800
102.	Net Hr, No. 5 = [33] [101]		—61	—1,230	—5,640	—9,840	—14,300	—17,900	—23,700	—28,300	—29,300	—20,900
103.	Hr, No. 6, Per Mole (Fig. 10)		4,070	3,860	3,850	3,840	3,810	3,795	3,770	3,740	3,700	3,700
104.	Net Hr, No. 6 = [35] [103]		23	720	3,950	7,140	11,700	16,500	24,300	31,700	37,900	27,000
105.	Hr, No. 7, Per Mole (Fig. 10)		35,800	35,600	35,600	35,500	35,500	35,500	35,500	35,500	35,400	35,400
106.	Net Hr, No. 7 = [37] [105]		23	780	2,800	5,640	7,550	8,350	9,650	8,670	8,340	3,040
107.	Hr, No. 8, Per Mole (Fig. 10)		62,500	62,900	62,900	63,000	63,000	63,000	63,000	63,000	63,100	63,100
108.	Net Hr, No. 8 = [43] [107]		3	—302	—5,000	—14,900	—28,200	—42,000	—59,300	—65,000	—61,000	—33,500
109.	Hr, No. 9, Per Mole (Fig. 10)		—22,400	—22,500	—22,500	—22,500	—22,500	—22,500	—22,500	—22,600	—22,600	—22,600
110.	Net Hr, No. 9 = [45] [109]		.	—19	—2,400	—5,500	—12,270	—20,300	—34,100	—50,900	—61,500	—45,000
111.	Hr, No. 10, Per Mole (Fig. 10)		—76,900	—80,400	—80,600	—80,800	—81,100	—81,300	—81,600	—82,000	—82,500	—82,500
112.	Net Hr, No. 10 = [48] [111]		....	....	—3,800	—4,660	—19,600	—43,000	—78,700	—124,800	—146,500	—111,800
113.	Total Hr = [94] + [96] + [98] + [100] + [102] + [104] + [106] + [108] + [110] + [112]		69,300	382,400	704,900	668,500	674,300	629,200	637,900	543,500	415,200	157,600
114.	Heat Input = [2] × 33 × 8000 = [2] × 26,400		792,000	792,000	792,000	792,000	792,000	792,000	792,000	792,000	*415,200	*157,600
115.	[114] — [113]		722,700	409,600	87,100	123,500	117,700	162,800	154,100	248,500	.....	.....
116.	Estimated Average Conversion		1	5.5	12	21	32	42.5	53.5	65.5	76.2	84.0
117.	C_n (per mole of C_3H_8 feed at [3] and [116])		39.4	40.6	41.1	41.1	41.3	41.4	41.6	41.7	.....	.....
118.	ΔT = [115]/(169.43 × [117])		108	60	12.5	17.8	16.8	23.2	21.9	35.2	.....	.....
119.	Temperature at Outlet of Reactor Section		1204	1264	1277	1294	1311	1334	1356	1391	1400	1400

*Reactor Section — Heat Input = Hr

drop from Equation 13. The temperature rise is obtained from the following energy balance:

$$\Delta H = C_p \Delta t + (\Delta H_R)(\Delta x) \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (17)$$

where

ΔH = heat input to section, Btu/(lb.-mole propane fed),
C_p = heat capacity, Btu/ (° F.) (lb.-mole propane fed),
ΔH_R = heat of reaction, Btu/(lb.-mole propane converted),
Δx = conversion, moles/(mole propane fed).

In the heating section, where the heat input rate is specified, ΔH is known and Equation 17 is solved for Δt. In the reactor section, where $\Delta t = 0$, it is solved for ΔH.

The temperature, pressure, conversion and heat input rate variations from Table 3 are shown graphically by the broken-line curves of Figs. 13 and 14. It will be noted that approximately 43 tubes are required for the specified conversion of 85% and that this conversion is reached with a reactor section of only 3 tubes. The absolute pressure at the outlet is 27 psi, which corresponds to the upper limit of the specified range. These results verify the choice of the 4½ inch tube diameter and the inlet absolute pressure of 70 psi.

Detailed Reactor Integration

After a promising reactor arrangement has been selected on the basis of simplified integrations the complete product distribution and corrected temperature-pressure-conversion relationships may be calculated by a detailed integration in which all of the reactions of Table 1 are considered. The general procedure is the same as that followed in the simplified analysis except that the complete average composition must be estimated for each incremental section as well as the temperature and pressure. These calculations are summarized in Table 4 on the basis of 169.4 lb.-moles of propane, the hourly charge. The integration is started at the fourteenth tube with the conditions calculated in the simplified integration for this point in the reactor. The simplified integration is rigorous up to this point because no appreciable conversion occurs at the low temperatures involved.

The results of Table 4 are summarized in graphical form by the solid line curves of Fig. 13 and 14. It will be noted that the results of the simplified integration for conversion, temperature and pressure are in fair agreement with the detailed calculations.

Conclusions

The rate equations summarized in Table 1 appear to represent the data available in the literature with as good agreement as can be expected in view of the wide discrepancies among the data themselves. Many of these data were recorded at a time when analytical methods were not satisfactory and considerable errors possibly existed, particularly for products present in small quantities. For this reason before great reliance is placed in the constants assigned to the rate equations in Table 1 it will be desirable to verify and adjust them by anlysis of reliable data from an operating commercial plant.

Acknowledgment

The work here reported was made possible by the financial support of the Wisconsin Alumni Research Foundation.

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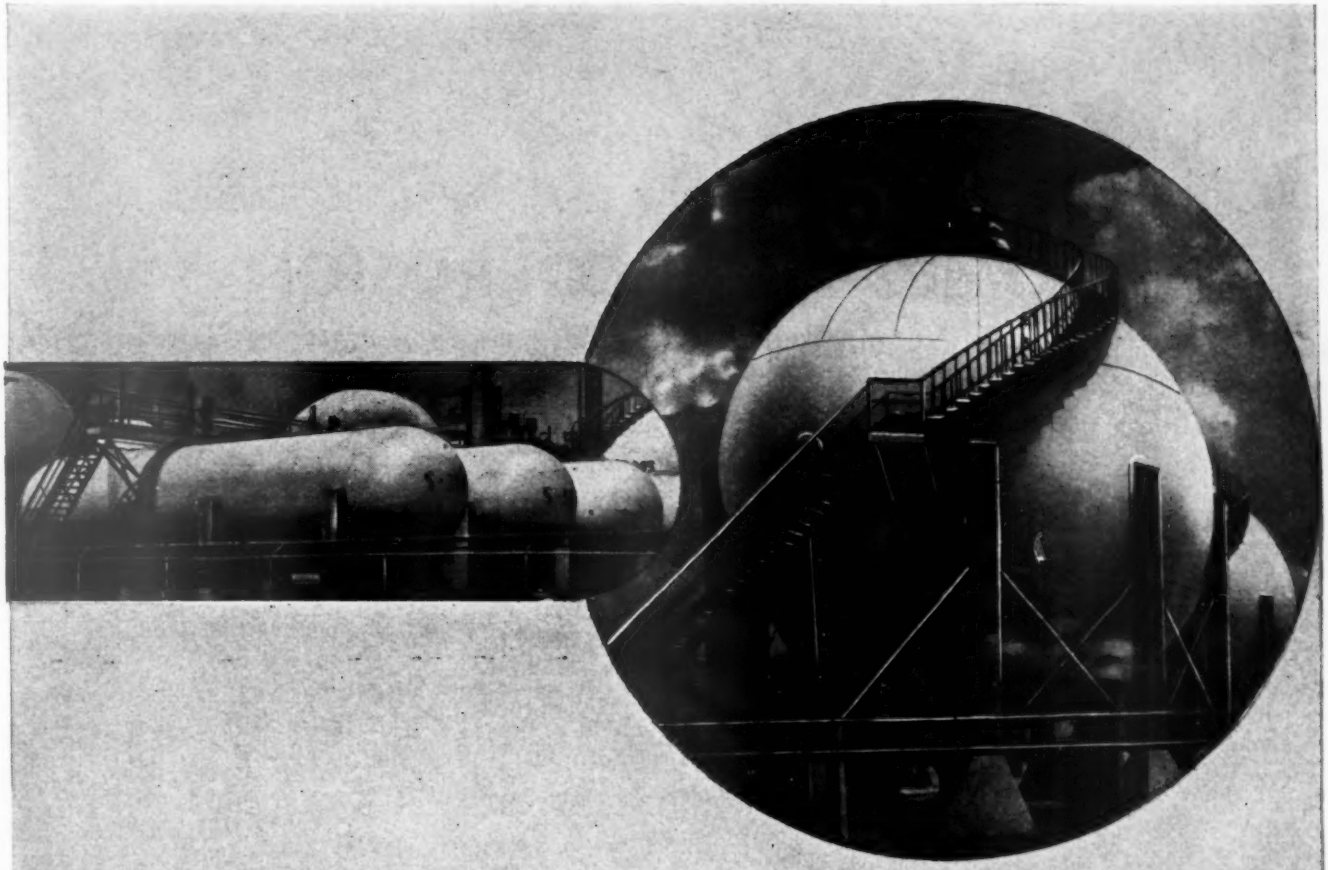

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New Techniques for Protection of Pipelines And Buried Structures Presented Before the Convention of Corrosion Engineers Society

By D. P. Thornton, Jr.
Assistant Editor NPN Technical Section

Means for the protection from corrosion of pipelines and buried structures received the major attention at the meeting in Kansas City May 7-9 of the National Assn. of Corrosion Engineers.

It was emphasized that the cost of corrosion of such equipment to refineries and in other branches of the oil industry, as well as to industry in general, includes far more than that of replacing the damaged equipment. Other contributing factors include:

Loss of conveyed products from leaks or breaks in lines.

Damage caused by such escaping materials when they reach adjacent soils or surface waters.

Loss of time where it is necessary to shut down certain operations to replace or repair lines or other equipment that have become corroded.

Cost of maintaining constant inspection to guard against leaks from corroded lines.

Cost of additional power required to maintain flow of fluids through corroded equipment.

Cost of whatever direct protective means may be adopted, such as special coatings, cathodic protection, paints or other means.

While the meeting program covered various industries and many types of corrosion problems, the following review covers only the papers pertaining to protection of pipelines and buried structures.

"Selenium Rectifiers for Cathodic Protection"—by W. F. Bonner, Federal Telephone Radio Corp., Newark, N. J.

This paper discusses the characteristics of selenium rectifiers as a means of securing direct current for cathodic protection or other purposes where small amperage currents of low voltage are required, and the incorporation of selenium rectifiers into commercial equipment to the best advantage. It does not, however, consider how the resultant current is to be applied, as in the cathodic protection of metal structures and pipe lines.

(Cathodic protection of buried metal pipe lines and structures is based on the theory that corrosion of such metal is the result of current flowing *from* the metal into the adjacent soil and carrying minute particles of metal with it. In cathodic protection the object is to offset the corroding current by supplying an external source of direct curent which flows from the soil *into* the metal.)

(Rectifiers are used in some cases to supply this external source of direct current, a rectifier being a device for converting alternating current—which is generally more readily available—into pulsating direct current. The basic element of the rectifier is the "plate," which, because of its construction, permits movement of current in one direction only. A single plate can handle only a minute current, so that a number of plates are made into a "stack" by assembling them one on top of the other until the desired current intensity is obtained.)

Rectifiers employed for cathodic protection must operate satisfactorily although unattended for long periods of time. They must be able to furnish direct current in outdoor locations with minimum effect due to changes and extremes in temperature. They must have good electrical efficiency and must also be capable of being protected against the effects of humid and salt-laden atmospheres. The selenium rectifier, introduced from Europe in 1938, has had a meteoric rise in popularity since its introduction because its electrical characteristics, long life and light weight have made it suitable for many military and civilian equipment applications.

The present selenium rectifier plate has a base-plate of steel or aluminum to which are applied a layer of crystalline selenium and a sprayed-on front electrode. Both layers are very thin. Rectification occurs at the boundary between the selenium and front electrode as a result of the formation there of a barrier layer which resists current flow from front electrode to selenium, but offers little resistance to current flow from selenium to front electrode.

Plates are made in sizes having rectifying areas ranging from 0.01 sq. in. to 25

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sq. in., and are assembled on insulated studs, separated from each other by metal washers which allow cooling air to pass between the plates and transmit current to the front and back of each plate. Such a combination is termed a "stack." Electrical connections are made by means of a terminal extending from the center to beyond the periphery of the plates, located centrally between plates and end of stack assembly as required.

In comparison, voltage applied in a forward (selenium to front electrode) direction meets a resistance approximately 1/100,000th of that in the reverse direction. In a 26-volt rectifier plate, for example, forward voltage of 1½ meets a nearly constant resistance of 10 ohms per sq. cm. Equal voltage in the reverse direction must overcome nearly a million ohms, although resistance in this direction decreases very slowly as voltage increases.

Other characteristics of the selenium rectifiers are good voltage regulation, negligible low-temperature effect on current flow and low leakage of current at perplate voltages above 19. Ratings of rectifiers are determined by the temperature rise of the plates, the rise being occasioned by the wattage loss through resistance of the rectifier in the forward direction—due to load current—and, in the reverse direction, from leakage current. For long life, in continuous operation the operating temperature of a rectifier should not exceed 167° F. and catalog ratings generally assume an ambient temperature not over 95° F.

Normal full load current is the rated current for a rectifier stack assembled with minimum standand spacing. Increasing plate spacing or adding cooling fins to the stacks, increases the amount of current the rectifier will carry with the same temperature rise. Stacks are made for continuous duty ratings up to 250% of rated full load. The main effects of increased current are the reduction of electrical efficiency and poorer voltage regulation. If ventilation must be restricted to keep out moisture or insects, it is preferable to select a unit operating at near 100% of normal full load current.

Also, for intermittent operation where time is allowed for the stack to cool to within 41° F. of the ambient temperature, a rectifier may be loaded to many times rated current. For intance, a 26-volt selenium plate may be operated at 200% of rating for 230 sec., 110 sec. at 300% of rating, 30 sec. at 500% rated current and 13 sec. at 1000% of normal full load without damage.

Single-phase power is generally used for cathodic protection work. Rectification cost for capacities up to 1.5 kw. is generally less for single-phase units. Above that, sufficient saving may be made through lower first cost and increased efficiency to use a three-phase circuit. Equipment having fractional ampere ratings has been found industrially satisfactory and, by the same token, power up to 540 kw. has been furnished in a single installation. Rectifiers are quiet in operation, have unlimited life, are mechanically rugged, need only minmum maintenance and are constantly ready for operation.

"Magnesium Anodes for the Cathodic Protection of Underground Structures"—by H. A. Robinson, Dow Chemical Co., Midland, Mich.

The electrochemical properties of magnesium as a galvanic anode for cathodic protection are:

1. A strong anodic solution potential, well above the other structural metals in the electromotive series of elements. Voltages of 0.7 to 1.3 are developed between magnesium and ordinary steel, even higher between magnesium and lead or copper.

2. Consumption of magnesium per ampere-hour of current is theoretically very small.

Early field trials were made with electrolytic or cell magnesium, having an average iron content of 0.03%, 1.3 in. diameter and 4 to 6 ft. long. Results were as follows:

1. Current flows were adequate to establish protection wherever soil conditions were favorable.

2. Anode life was excessively short, due to the combined effects of segregation and a high rate of local corrosion.

3. Anode efficiencies were poor (5-30%) due to the high rate of local corrosion.

The early electrodes were, because of their length, especially susceptible to seggregation effects, since they were likely to traverse several strata of soil. Now a shorter and more massive electrode is used.

Laboratory investigation following these early field trials indicated that:

1. Regardless of composition, the efficiency of the magnesium electrode improves with increasing current density.

2. Cell magnesium anodes must operate at high current densities (500 ma. per sq. ft. or better) to realize efficiencies of 50% or more.

3. High purity magnesium-aluminum or magnesium-aluminum-zinc alloy anodes perform much more efficiently than cell magnesium over the low current density range (200-500 sq. ft.) normally prevailing for field installations.

4. Magnesium anodes perform more efficiently in sulfate than in chloride electrolytes, high chloride ion concentrations are particularly effective in reducing anode efficiencies whereas electrolyte concentration effect is not so pronounced in sulfate electrolytes.

5. Corrosion pattern at anode is affected by current density, anode composition and electrolyte composition and concentration, so that: (a) uniformity of anode composition increases with increasing current density; (b) pitting attack is observed at high concentrations of electrolyte—saturated sodium chloride—unless anode operates at high densities while less soluble electrodes, such as calcium sulfate and magnesium sulfite, produce well distributed attack down to current densities of 35-70 ma. per sq. ft. and (c) in calcium sulfate and magnesium sulfite electrolytes, anodes of cell magnesium and Mg—6% Al—3% Zn alloy (Dowmetal) exhibit most uniform corrosion attack at low current densities.

6. Of the magnesium anode compositions tested to date, the Mg—6% Al—3% Zn alloy exhibits best overall performance although potential is 0.1 v. below that of cell magnesium.

Field tests and laboratory data indicate that, for current densities of about 40 ma per sq. ft., current recoveries of 500-600 ampere-hours per pound, together with good distribution attack and freedom from polarization effects, may be expected from Dowmetal operating in favorable chemical environments. Anode performance in the field has become more efficient as improvements in its composition and environment are incorporated.

"Neutralizing Circuit for Elimination of Long Line Current Corrosion"—by W. R. Schneider, Pacfic Gas and Electric Co., Emeryville, Calif.

This paper decribes a method of electric protection without use of ground electrodes for cables and pipes that are being corroded by long line or stray currents. Soil currents and the accompanying danger of cathodic protection interference which may damage other buried structures are avoided.

Direct current from an outside source is sent through the pipe or cable sheath. Regulated to proper intensity, it will cause a drop of potential along the line and neutralize the soil current causing corrosion. The return line is an electric wire, which may be strung with the pipe (but carefully insulated therefrom) or on poles.

Additional protection can be given by adding a small ground electrode, carrying a correspondingly small amount of current. Use of this electrode will eliminate self-corrosion of the pipe or cable and at the same time will give protection to lines extending beyond the immediate vicinity of the corrosion eliminator.

Cost of the copper conductor required to span the pipeline or cable to be protected is usually less than the savings on the ordinarily required ground electrode. Power losses and power costs, particularly in high resistance soil connections, are lower than with conventional cathode protection.

"Results Obtained from Five Years of Cathodic Protection on 24 in. Gas Line Rapidly Deteriorating from Bacterial Corrosion"—by W. E. Huddleston, Bartlesville, Okla.

The pipeline on which cathodic protection was applied to mitigate bacterial

corrosion was 63.413-lb., 24-in. welded gas transmission line having a wall thickness of 0.250 in. Laid in 1940, it was coated with a commercial tar enamel but not wrapped. Primary area of corrosion was a North Canadian river crossing and a swamp on one side.

First leaks occurred in 1940, with frequency of leaks maximizing in 1941. Tests for galvanic corrosion, cathodic interference and electrolysis could not account for the large amount of pitting observed. The pits were filled with a dark brown substance which laboratory analysis revealed to be iron sulfide. Other investigations, of soil, etc., indicted conditions were favorable for sulfate reducing bacteria.

The line then was protected by cathodic means. A 35-amp. rectifier was installed in the area, pipe-to-soil potentials above 1 v. were established over the entire area. This system has operated continuously through the last 5 years with only a 2-day lapse due to high-line failure.

The leaks, which had been developing at rate of about one per 10-15 days, dropped to six in the following 26 months after cathodic protection. No new leaks have developed since.

Since being protected the line has been excavated, in part, for inspection, and examination revealed it was in good condition. This leads to the author's conclusion that cathodic protection will give excellent results in combating microbiological corrosion.

"Use of Fibrous Glass in Underground Pipe Protection"—by J. A. Grand and S. M. Peek, Owens-Corning Fiberglas Co., Toledo, O.

Fibrous Glass underground pipe wrap is a thin, porous, flexible mat of microscopically fine glass fibers, bonded together with a non-corrosive agent to form long rolls of the material. It serves as a carrier and reinforcing agent for impregnants or coatings such as asphalt, coal tar enamels and synthetic resins and is used also for physical, chemical and electrical protection of underground pipe.

The fibers are non-corrosive and do not cause corrosion when in contact with metals. The mat is resistant to organic solvents and soil acids, is also unaffected by hot application of commonly used impregnants or coatings, and has a low moisture pick-up because individual fibers are practically non-absorbent. When used with proper coatings or impregnants it provides a moisture tight band for the pipe.

The fiberglas mat maintains good tensile strength over a wide range of temperatures. This is one reason why it retains large amounts of coatings or impregnants. Tensile strength is sufficient to withstand pull found in conventional pipe-wrapping machines. The material does not reduce the dielectric strength of the coating or impregnant and has a high pick-up factor, especially with bitumens and synthetic resins. A standard roll of 12-in. width weighs less than 5 lb., mat is 450 ft. long, and costs about 1c per sq. ft. Its flexibility and strength, it is said, permit easy application with conventional equipment, the control of tension in wrapping regulating the penetration of coating or impregnant. Paper may be employed over the wrapping as a further protection if bad backfill conditions prevail.

"The Installation and Protection of Underground Gas Distribution Systems with Pipe Line Enamels"—by P. D. Mellon, Canadian Western Natural Gas, Light, Heat and Power Co., Ltd., Calgary, Alberta, Canada.

This Canadian company has been experimenting for several years with many types of enamels, coatings and wrappings. For the time being, however, it has standardized on coal tar enamels exclusively as a protective coating for all underground steel pipe.

The Canadian company believes in protecting all its equipment, where possible, before corrosion takes its toll, as a means of reducing operating costs. Pipe treated with any of the widely-known coatings on the market today will allow the operator to reduce yearly amortization charges with a corresponding reduction in operating costs. Further, installation of thin wall or lighter weight steel pipe, adequately protected, is permissible where protection is given, the pipe should have a life two to three times that of unprotected standard weight bare pipe.

Because of the location of its facilities, Canadian Western must coat its own pipe. It is cleaned, primed and coated at the warehouse since there are no suppliers nearby stocking protected pipe.

Rust and scale are removed by mechanical cleaning, leaving a clean smooth surface. All pipe from 1-in. to 6-in. is coated by dipping, both for priming and coating. A hard, semi-pliable coating, impervious to moisture and known to the trade as "Waterworks Enamel," is used.

After priming, the pipe is dipped into a trough containing the hot enamel (thermostatically controlled tank). For handling pipe in this and the priming operation a special cup with handle is fitted over each joint, extending a distance of 9 to 12 in. from each end. This serves the two-fold purpose of keeping the enamel from entering the inside of the pipe and providing a bare section at each end to allow for field welding.

The pipe then is electricly "jeeped" or tested for "holidays." Finally, it is spirally wrapped in a wrapping machine with a tar-saturated asbestos felt. Upon installation, unprotected ends at each

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joint are field primed, coated and wrapped after assembly over the trench.

Fittings, such as tees, ells, flexible couplings, expansion sleeves and the like, are coated in special pans. They are assembled around the spot and filled with enamel. All such field processing is likewise electrically tested before wrapping.

For large pipe, in excess of 6-in. dia., "standard pipe enamel" is used. This is applied to pipe over the trench, and the pipe buried as soon thereafter as possible. Couplings or expansion joints, however, are coated with the "Waterworks Enamel."

"Corrosion in Cooling Water Systems and Service Lines"—by F. T. Redman, Hall Laboratories, Inc., Pittsburgh.

Corrosion commonly occuring in cooling water systems and service lines results generally from high pH, always in the presence of oxygen. It is electrochemical action, resulting in formation of iron oxides. The products of corrosion either are deposited generally over the pipe (when pH is less than 5) or else in the form of tubercles (pH over 7.5).

This type of corrosion can be controlled by the use of sodium metaphosphate, which is absorbed on the pipe wall. To control pH, sulfuric acid is used to bring the value within the range of 5 to 6.5. The presence of copper or brass couples has no effect on the treatment. Metaphosphate concentrations ranging from 2 to 25 ppm. are maintained in the water system, depending on the severity of the corrosion.

"Designing to Prevent Corrosion"—by R. H. Brown and R. B. Mears, Aluminum Co. of America, New Kensington, Pa.

This paper first discusses the general mechanism of corrosion, electrical and chemical, then follows with methods for their elimination.

Galvanic corrosion effects can best be eliminated by using a single composition of metal or alloy for the entire construction, or by selecting alloys where there are no galvanic possibilities known. The only other solution is to completely insulate the dissimilar metals electrically. Painting both anodic and cathodic surfaces will help reduce undesirable effects of galvanism. Sprayed metallic, hot-dipped or electrodeposited coatings can be used successfully. Alternatively, cathodic protection, either by electrical or sacrificial anode means, may be employed.

Joints should always be protected by caulking or priming with any of the well-known compounds. This is frequently an excellent, cheap protection.

Zinc electrodes as anodes have been widely used in protecting steel or aluminum structures. Now magnesium and aluminum alloy anodes are being used because they have higher solution potentials than zinc and so provide more current per anode. Having lower electrochemical equivalents than zinc, theoretically at least they will provide more ampere-hours per pound of metal attacked than zinc will.

For protecting the amphoteric metals, such as aluminum and lead, galvanic electrodes have the advantage of more easily avoiding excessive currents and thus preclude possibility of cathodic corrosion. This is the principle used in coating galvanized steel. Alclad alloys of aluminum are another example.

It is good design to avoid crevices and use special protection at joints, pockets, and other inaccessible areas. Design for frequent cleaning and easy ventilation where possible. Give the least possible chance for moisture entrapment and provide means for complete drainage. Another characteristic of good design is to avoid sharp corners and protuberances whenever possible and, above all, design for ease in repairing corrosion damage where it is impossible or not feasible to provide cleaning and ventilation.

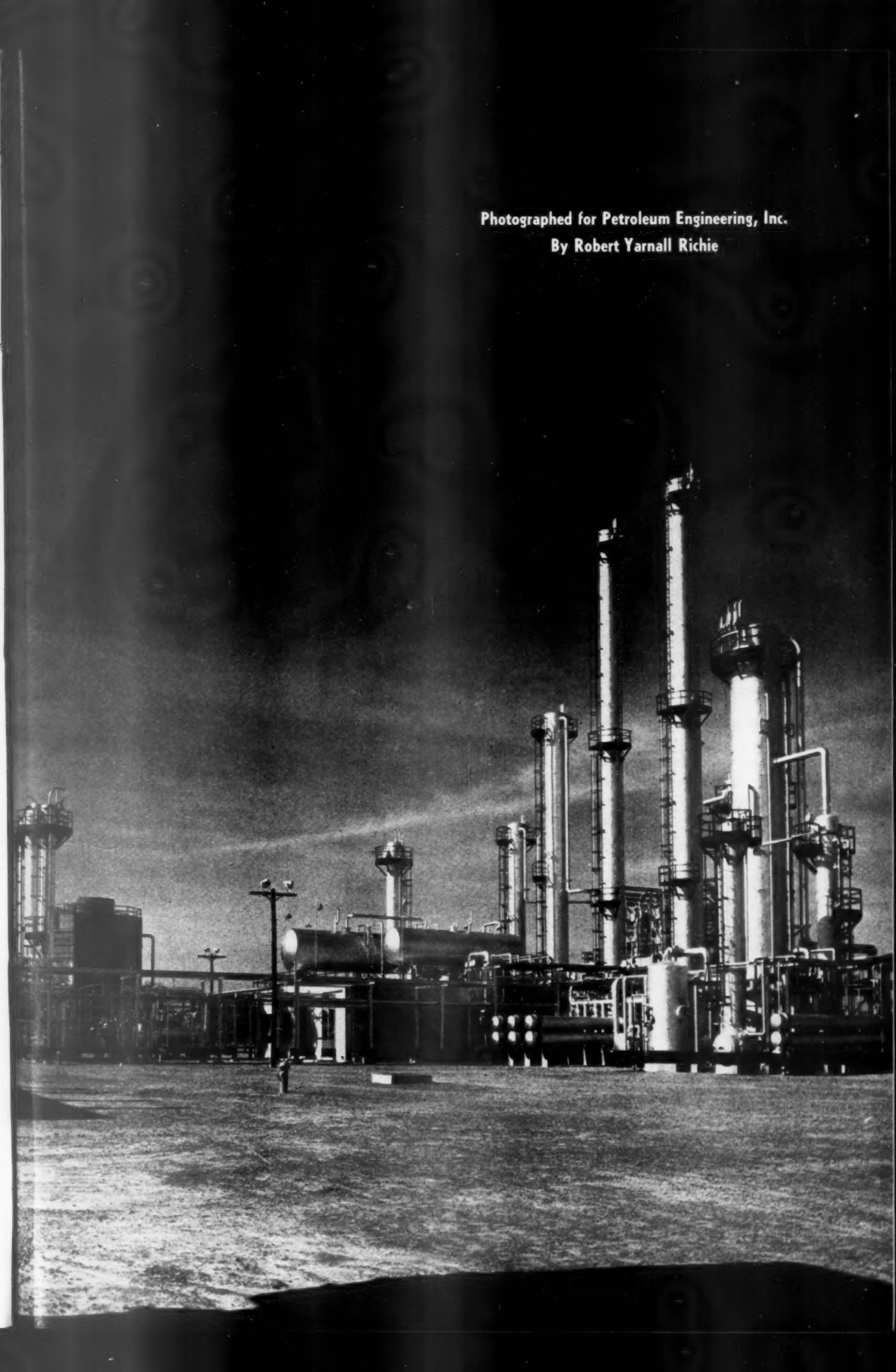
"Designing Water Pipe for Long Life and High Carrying Capacity"—by G. H. Garrett, Thompson Pipe & Steel Co., Denver.

Where mildly corrosive conditions are expected, the easiest way to assure long life of the installation is to pay strict attention to the homogeneity of the steel to be used. A prime requirement is that the steel should contain 0.05% or less of sulfur, as it has been shown that higher sulfur contents predispose to corrosion under even mild conditions.

Where severe corrosion conditions are expected, either from the soil or the water, internal and external coatings are the best insurance. A great many of these materials have been developed. Properly applied to hermetically seal the pipe, they will prevent occurrence of corrosion. Plasticized coal-tar enamels are among the most satisfactory materials, and may be applied inside, outside, or both to approximately 3/32 in. thickness. Such coatings have the additional advantage of providing a smooth surface on the inside, with resultant favorable effect of the frictional coefficients, or the "C" factor of the Williams-Hazen equation.

This author cites a number of examples where such coatings have been used with extremely good results. In one, the pipe was coated with cement after coating with a coal-tar enamel. When dug up a few years later, it was found soil was so corrosive that the concrete coating had been almost completely disintegrated, yet the enamel coating was intact and no corrosion of the pipe evident. Another example cited was an oil pipeline in Texas and Oklahoma, 225 miles long, and laid in 1927-1928. Dug up 16 years later, in 1943, it was found that no corrosion had occurred and the line was relaid elsewhere in its original condition—without recoating.

This cycling plant, recently completed, is one of many gas processing units designed and constructed by Petroleum Engineering, Inc., in the past 16 years of continuous service to the industry. Petroleum Engineering, Inc., Offices: Houston and Tulsa.



Photographed for Petroleum Engineering, Inc.
By Robert Yarnall Richie

HYDROFORMING

A Catalytic Method for Naphtha Upgrading

By L. R. Hill, G. A. Vincent and E. F. Everett, Jr.
Process Engineering Department, The M. W. Kellogg Co.

First detailed information is given in the accompanying article exclusive to NPN's Technical Section on the Hydroforming process, which term is linked, in most refiners' minds, with the high volume production of toluene during the war.

Developed just prior to the war, the first commercial installation went on stream in 1940 and all told eight commercial units have been installed. These units are now being operated in the original function of the process to improve low grade naphthas for motor gasoline. Data from the post-war runs at four plants is included in the article.

Hydroforming is a catalytic reforming reaction taking place in an atmosphere rich in hydrogen, which produces a high-octane aromatic gasoline, stable because of the absence of olefins. The yield product is termed Hydroformate. Sulfur contained in the naphtha feed is 90% removed in the operation, so the process is also one of desulfurization. A by-product is a non-condensable gas rich in hydrogen.

Special features of the reaction-regeneration system are described. The liquid and gas streams are processed in a conventional recovery system. Operating data given includes results where the charge stock was largely derived from Mid-Continent crude, also where the charge was predominantly high sulfur West Texas naphtha. Relationship of yield to octane number is given, lead susceptibility of the hydroformed gasoline and results using a heavy naphtha charge stock of over 450°F. end point.

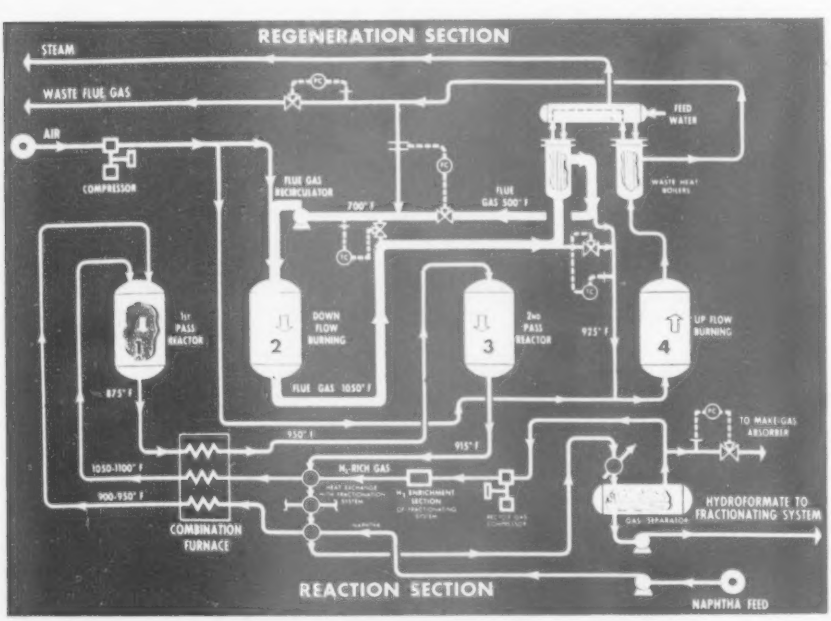


Fig. 1—Flow diagram of reaction-regeneration system of Hydroformer unit

HYDROFORMING is a catalytic process for converting low-octane naphthas into stable, high-octane, sulfur-free gasoline by means of dehydrogenation and cyclization. Little information has hitherto been published on its operation for motor gasoline because, during the war, all eight installations were adapted to the production of toluene and aviation gasoline blending components. A specially selected 7-carbon atom petroleum naphtha, rich in methyl cyclohexane and ethyl cyclopentane, was fed to the units for this purpose.

Since V-J Day, however, Hydroformer operation has been shifted to its original function of upgrading full boiling-range heavy naphthas for use as automotive gasoline. These post-war runs at the various plants have produced considerable data of interest and it is thought that a discussion of the commercial results currently being obtained may be of assistance to refiners.

Yield and Product Characteristics

The naphtha conversion or reforming is effected by a catalyst at temperatures of 900-1000° F. and pressures of 200-300 psig in an atmosphere rich in hydrogen. The hydrogen partial pressure is maintained by recycling a hydrogen-rich gas, derived from the process, to the reaction zone along with the vaporized fresh feed.

Naphthenes (cycloparaffins) in the feed stock are dehydrogenated, and in some cases slightly rearranged, to form aromatics. Considerable cyclization of straight-chain hydrocarbons also takes place. If any olefins are present, as is the case when some cracked naphtha is included in the feed, these are almost completely converted to paraffins or ring compounds. In addition, 90% of the sulfur contained in the naphtha feed is removed so that the process is also one of desulfurization. This latter characteristic assumes increasing importance with the current trend toward the processing of sour crudes.

The resulting gasoline is highly aromatic, has excellent antiknock characteristics, and is very stable because of the absence of gum-forming di-olefins. Other products are non-condensable

gases containing a considerable proportion of hydrogen, a small amount of highly aromatic polymer and a carbonaceous residue left on the catalyst.

Yields of 78-80 vol.-% of 80 CFR-M octane gasoline can be obtained, with the remaining 20-22% being split approximately three-fourths to C_4-free gas and one-fourth to polymer and carbon. Because operation for the lower octane Hydroformates results in exceedingly low Reid vapor pressures, it is possible to obtain a yield of 69 octane gasoline equal to 100% of the feed, by blending in extraneous butanes to the 10 lb. Reid level. This latter product can be brought up to 80 CFR-M octane with the addition of only 1.5 cc of TEL.

Description of Process

The Hydroforming units consist of two principal parts: (1) the reaction-regeneration system, and, (2) the recovery-fractionation system.

Fig. 1 shows a flow sheet of the first mentioned part of the plant. There are four reaction vessels. This number is employed for two reasons: first, regular regeneration of the catalyst is desirable, necessitating duplicate reactors for continuous operation and, second, an endothermic heat of reaction makes it expedient to introduce additional heat at an intermediate point in the reaction system. This is most easily accomplished by using two vessels for the reaction rather than one. All four reactors are identical and are filled with a molybdena-on-alumina catalyst in granular or pellet form of approximately 2 to 4 mesh size.

Flow Through Apparatus

Naphtha feed and recycle gas are heated in separate coils in a combination furnace and then enter the first-pass reactor at a temperature of about 975° F. and a pressure of 240 psig. The reactants fall about 100° in passing through the reactor, because of the endothermic reaction. Reaction temperature is restored by passing the product stream through a reheat coil in the combination furnace before contacting the second half of the catalyst mass. The larger part of the highly endothermic heat of reaction, however, takes place in the first-pass reactor; therefore the temperature drop in the second-pass vessel is only 30-60°.

The hydroformed products leave the second-pass reactor at about 915° F. and 225 psig and pass through a series of transfer line exchangers wherein the heat contained in the products is transferred to cold fresh feed and recycle gas and also to various streams in the fractionation system. All of the heat necessary to operate the latter system is furnished by the transfer line material.

The last transfer line exchanger is a water-cooled condenser which lowers the hydrocarbon temperature to about 100° F. Following this cooler is a gas separator in which liquid Hydroformate and gas are separated at about 185 psig. The liquid is pumped to the fractionation system and the major portion of the gas is compressed to 350 psig for recycling.

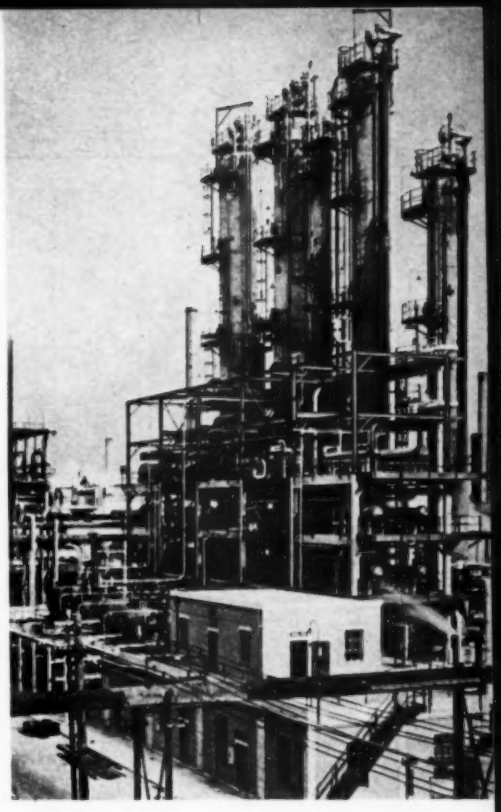
Regeneration Remotely Controlled

After 4 to 8 hours of reaction, the coke-like residue deposited on the catalyst must be removed and the molybdenum in the catalyst reoxidized. When sulfur is present in the feed stock, this element forms sulfides with the molybdenum (upwards of 90% of the sulfur in the feed is removed in this way). Therefore, each reactor is removed in turn from reaction and is placed on regeneration.

An elaborate electric time-cycle control mechanism energizes motor-operated split-wedge gate valves which switch reactors between all of the various operating positions involved in the regeneration procedure. This entirely automatic sequence of valve operations is so arranged that the principal flows, i.e., naphtha, recycle gas, recirculated flue gas, and air, are uninterrupted throughout the cycle.

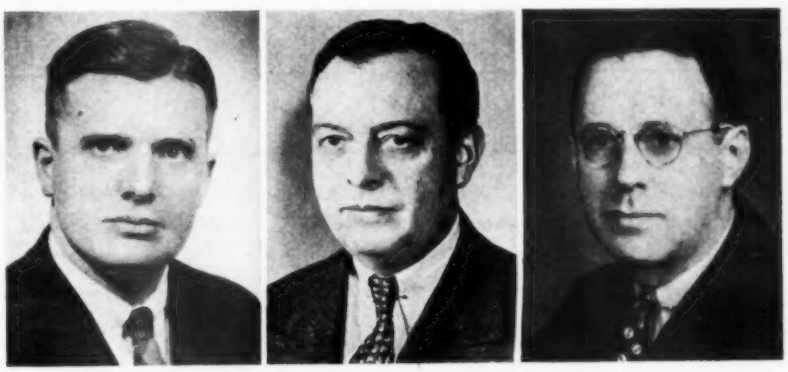
The regeneration step involves combustion by means of air diluted with recirculated flue gas to control the temperature. Adequate provision is made for recovery of products in the reactor at the end of the reaction period. Both downflow and upflow burning are employed to ensure complete regeneration and catalyst temperatures are controlled to a maximum of 1050-1100° F.

The liquid and gas streams from the



Hydroforming unit at the Whiting refinery of Standard Oil Co. (Ind.), which during the war produced more toluene than was manufactured by all toluene plants in the U. S. during World War I. The plant had a rated toluene capacity of 58,000 gallons a day. Construction of the unit, one of the largest plants built by private capital in the Ordnance Department's aromatics program, was begun in 1942

MEET THE AUTHORS . . .



E. F. Everett, Jr. **L. R. Hill** **G. A. Vincent**

Luther R. Hill (center) is director of the process engineering department at the M. W. Kellogg Co. A chemical engineering graduate of the U. of Texas, Mr. Hill came to Kellogg in 1929, and as process design engineer worked successively on combination, thermal cracking, atmospheric and vacuum distillation, naphtha reforming, gas reversion and thermal polymerization units. In 1939 he assumed charge of hydroforming and toluene unit design, and later of butadiene plant design. **G. A. Vincent** (right) is the Kellogg engineer directly responsible for hydroforming process design. He has been with the company for 16 years and has been closely identified in the past with the development of propane deasphalting, dewaxing and solvent treating. **Edward F. Everett, Jr.** (left) has devoted nine years to the engineering development of gas recovery plants, hydroformers, butadiene plants and catalytic-cracking units. His interest in the design and development of hydroforming dates from its early phases in 1939.

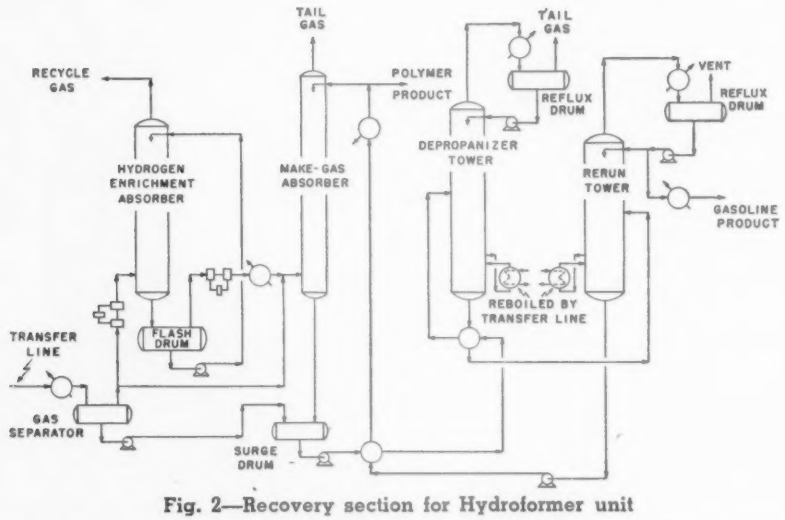


Fig. 2—Recovery section for Hydroformer unit

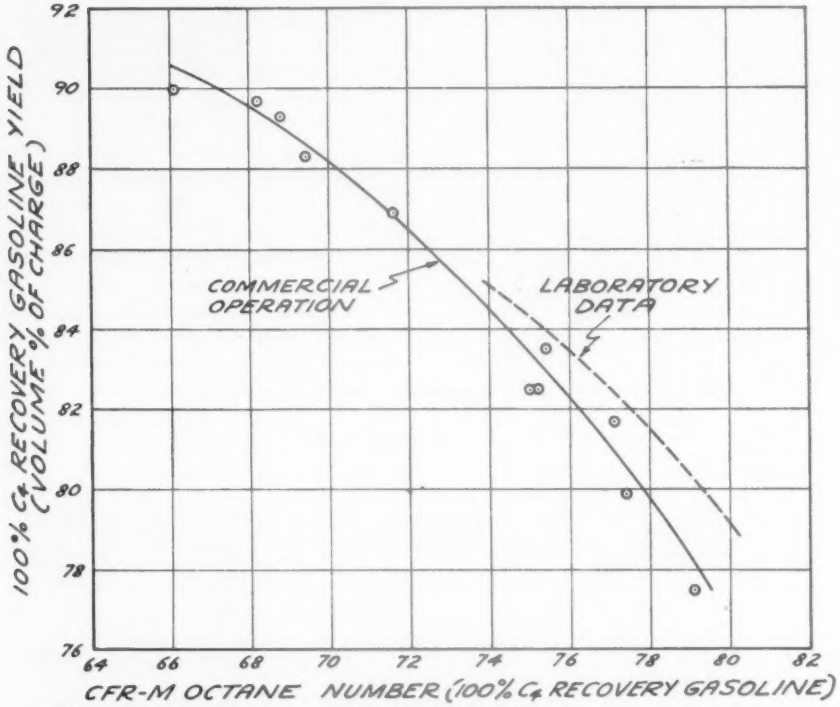


Fig. 3—Relationship between yield of 100% C_4 recovery gasoline and octane number

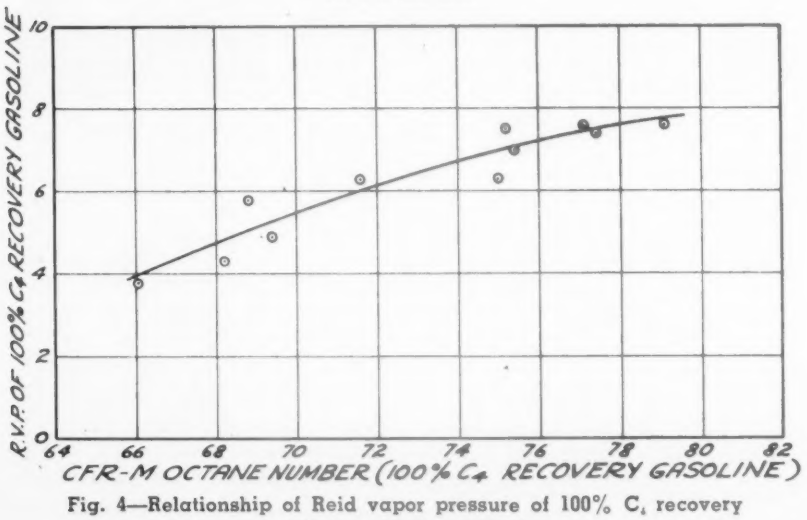


Fig. 4—Relationship of Reid vapor pressure of 100% C_4 recovery gasoline and octane number

reaction step are processed in conventional recovery equipment, a flow diagram of which is given in Fig. 2.

The heavier components in the compressed recycle gas stream are absorbed in the hydrogen enrichment absorber so that the overhead from this tower is a lean gas of increased hydrogen concentration which passes to the recycle gas exchanger and thence to the combination furnace as mentioned above. The make-gas absorber recovers butanes and heavier components from the product stream. The bottoms of this tower are combined with the liquid from the gas separator to form the feed to the depropanizer tower.

The depropanized material passes to the rerun tower, which operates at 5-10 psig and from which the gasoline product is taken overhead. The bottoms of the rerun tower consist of Hydroformer polymer, which is used as lean oil in the make gas absorber. The net polymer product is highly aromatic and may be processed for use as a solvent in the paint and plastics industries.

Operating Data

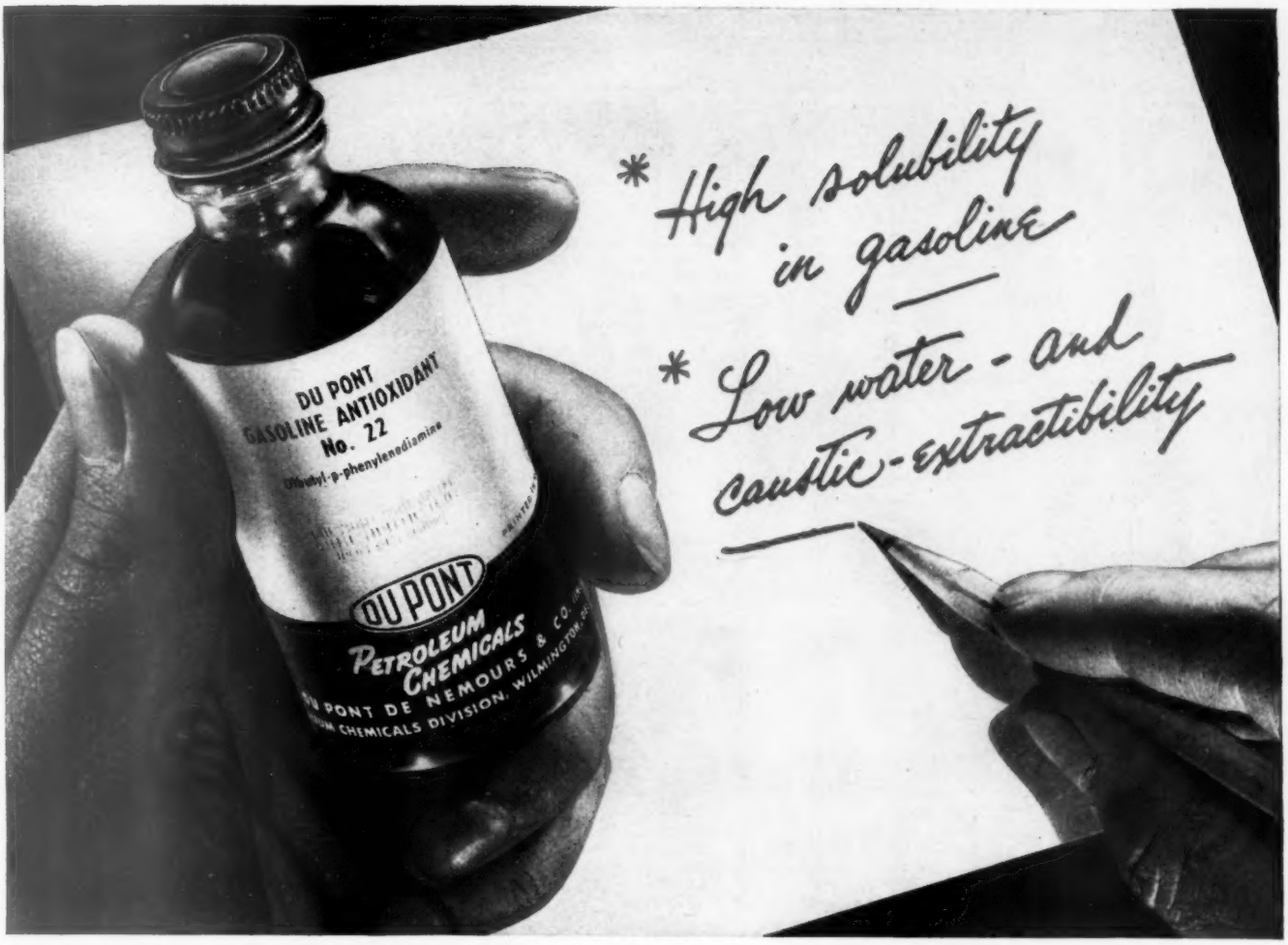
Process data covering the recent operation of four Hydroformers on as many different feed stocks have been obtained and summarized on a comparative basis. Most of the data are from operations where the charging stock was largely derived from Mid-Continent crudes. One series, however, is based on a charge consisting predominantly of West Texas naphtha of comparatively high sulfur content. All yields have been corrected to an output basis, although the weight balances were almost between 97 and 102%.

Table 1 shows the results obtained with one of the Mid-Continent naphthas, which may be considered typical of all runs on this type of feed stock. It will be noted that a weight yield of 80.1% of 100% C_4 recovery gasoline is obtained. This product has an octane number of 76.6, which can be brought up to 82.6 by the addition of only 1cc. of tetraethyl lead. The very low Reid vapor pressure of 5.1 results in important economic advantages, as outlined below.

Six Major Advantages

The results of several different commercial runs have been carefully analyzed and a summary of the findings presented in the following graphs and discussion:

1. Yield-Octane Relationship — The relationship between yield of 100% C_4 recovery gasoline and its octane number is plotted in Fig. 3. A CFR-M clear octane range of from 66 to 79.5 is covered, with a corresponding vol.-% yield ranging from 90.6 to 77.6. The two lowest octane points represent operation at about 125% of design throughput, while the balance are at substantially design capacity. The dashed line rep-



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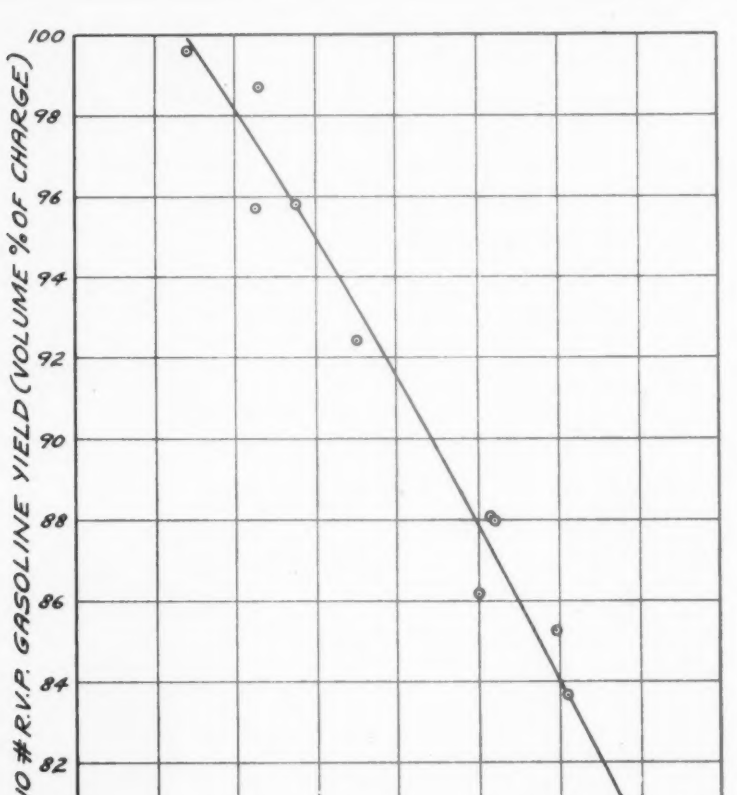

Fig. 5—Effect of adding extraneous butane to bring the vapor pressure up to 10 lbs.

resents the laboratory's prediction for these operations, based on Kellogg pilot plant runs.

2. Yield-Octane Relationship (10 lb R.V.P. Gasoline)—An important characteristic of Hydroformer gasoline is its low Reid vapor pressure (see Fig. 4). Because of this, refiners can profitably benefit by blending butane (95 octane blending value) into the Hydroformer gasoline in amounts up to 10% by volume to bring the gasoline up to the nominal 10 lb. Reid vapor pressure specication. A low-cost material can thus be used where available to increase the volume and octane number of the gasoline product.

The data used in Fig. 3 have therefore been recalculated to a 10-lb. Reid vapor pressure basis to show the effect of using extraneous butane to bring the vapor pressure up to the 10-lb. figure. The results of this calculation are plotted in Fig. 5. It will be observed that at one end of the curve a yield of 100% of 68.8-octane gasoline is obtained. An octane of 80 CFR-M can be obtained by adding 1.5 cc. of TEL to this material. At the other end of the curve is 80% of 80 octane, which will come up to 85 octane with 1 cc. of TEL. By thus varying operating conditions in the Hydroformer, the refiner is given great flexibility to meet varying market demands.

Fig. 6 indicates the volume of extraneous butanes which may be added to Hydroformer gasoline to bring it up to 10 lb. vapor pressure. Notice that butane to the extent of 9 vol.-% on feed is required to bring the 66-octane gasoline up to 10 lbs., resulting in a 10% increase in gasoline volume. At the other extreme, only 3 vol.-% can be used with the 80-octane gasoline.

3. Yield-Octane Improvement Relationship—In Fig. 7 is shown the variation in yield from 90 to 78 vol.-% of 100% C_4 recovery gasoline for a range of octane improvement of the naphtha

TABLE 1—Results from Hydroforming Typical Mid-Continent Naphtha

	Mid-Continent Virgin Naphtha	Hydroformed Gasoline
Gravity, °API	51.5	50.0
ASTM Dist., °F.		
IBP	212	111
10%	263	165
50%	329	269
90%	378	348
EP	408	393
Oct. No., CFR-M Clear	34.4	76.6
+ 1.0 cc. TEL		82.6
R.V.P., psi		5.1
Lamp Sulfur, wt.-%	0.023	0.008
Aniline Point, °F.	171	64
Bromine Number	0.8	4.0
Yields, Wt.-% of Feed (Output Basis)		
C_4-Free Gasoline		76.4
Butanes		3.7
Polymer		4.1
C_4-Free Gas		14.6
Carbon		1.2

Interior of pump house of a hydroformer installation showng the steam turbine ends of pumps. The choice between turbine and electric drives generally is influenced by the cost of utilities. At this installation, steam was cheaper and also there was a desire to be able to vary the speed of rotation. In steam turbines this can be done by merely varying the steam flow, whereas in electrically driven pumps expensive variable speed motors are required

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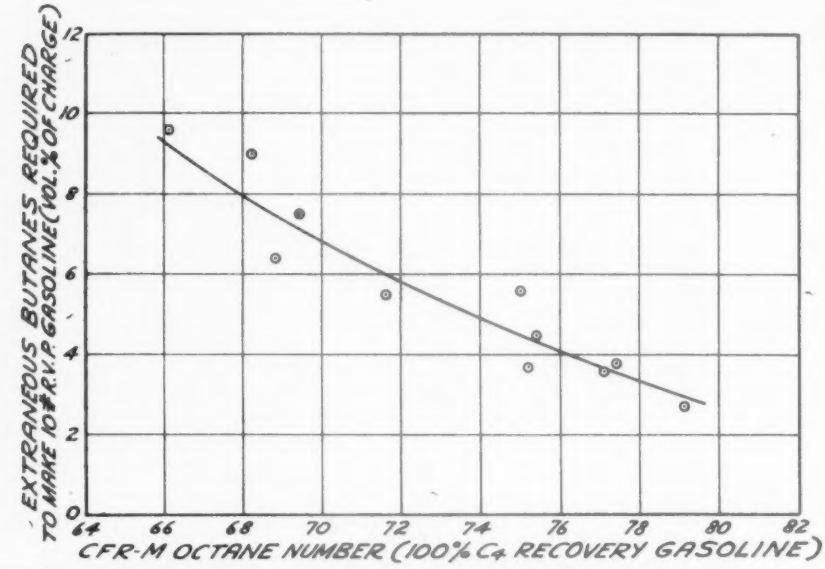
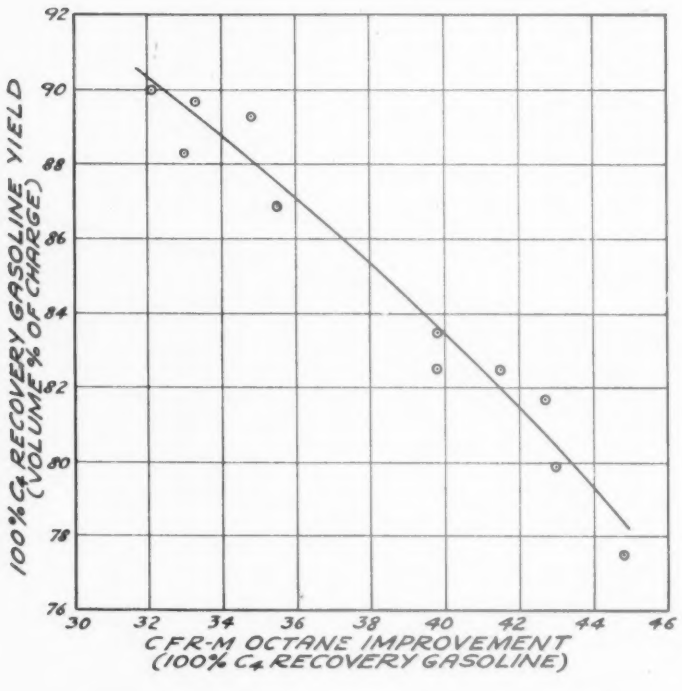


Fig. 6—Extraneous butanes required to bring Hydroformer gasoline up to 10 lbs. vapor pressure

charge of 32 to 45 points respectively. No other commercial process approaches such octane improvement.

4. Lead Susceptibility of Hydroformed Gasolines—In addition to low Reid vapor pressure, an important feature of Hydroformer gasoline is its remarkably high lead susceptibility. The data bearing on this characteristic have been plotted in Fig. 8. It is shown that a 100% C_4 recovery gasoline with a 68-clear octane number will lead to 77 with 1 cc. TEL and to 83 with 3 cc. TEL. At the other end of the octane range, the 80-octane gasoline will lead to 86 with 1 cc. and to 89 with 3 cc.

This lead susceptibility is much better than that of thermally or catalytically cracked gasoline and is equaled only by that of alkylate or isomate, which are specialty products seldom made in volume comparable with the output of a Hydroformer. The high lead sensitivity



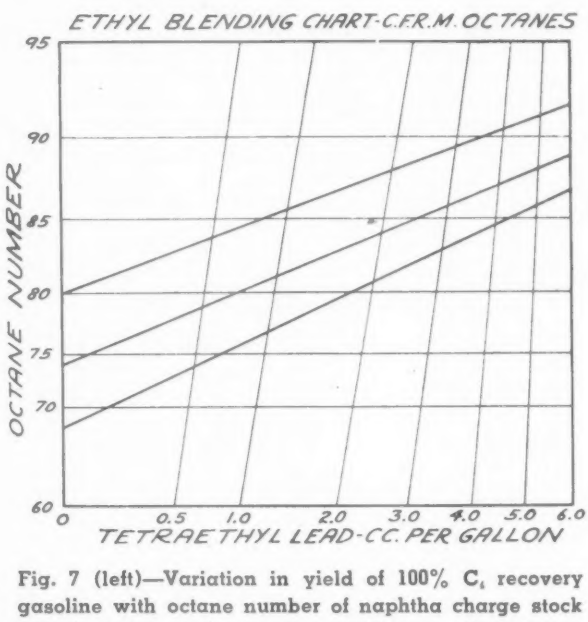


Fig. 7 (left)—Variation in yield of 100% C_4 recovery gasoline with octane number of naphtha charge stock
Fig. 8 (above)—Lead susceptibility of Hydroformer gasoline

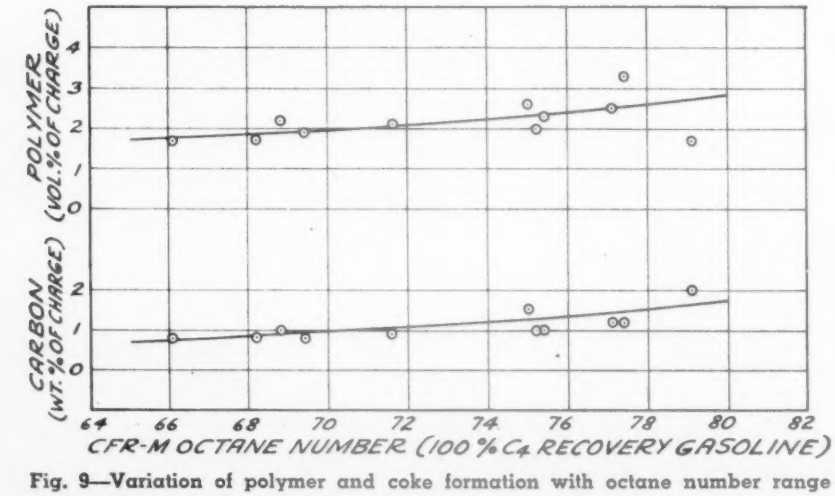


Fig. 9—Variation of polymer and coke formation with octane number range

of Hydroformates is a result of the absence of olefins and sulfur compounds.

For those refiners who prefer the use of CFR-Research octane values rather than Motor, Table 2 shows the relationship of these two methods of octane measurement when applied to Hydroformer gasoline. The Research method gives a result about 5 octane numbers higher than the Motor method.

5. Polymer and Coke vs. Octane Number—The variation of polymer and coke formation with octane number of 100% C_4 recovery gasoline is shown in Fig. 9. The gasoline-free polymer is here shown to vary between about 1.8 and 2.8 vol.-% on charge as the octane number of the gasoline rises from 66 to 80. The lower curve shows carbon to

TABLE 4—Data for Hydroformer Runs on Mixtures of West Texas and Mid-Continent Virgin Naphthas*

Run No.	1	2	3	4	5	6	7	8
Kind of Catalyst	Gel	Gel	Gel	Gel	Gel	Gel	Gel	Gel
Age of Catalyst in Stream Days	148	155	162	169	187	194	201	208
Naphtha Coil Outlet, °F.	950	946	940	940	940	935	930	930
Recycle Gas Coil Outlet, °F.	1050	1050	1050	1050	1050	1050	1050	1050
Reheat Transfer Line, °F.	944	941	941	940	944	939	934	935
Average Catalyst Bed Temperature								
Primary Reactor, °F.	914	905	896	899	893	900	906	911
Secondary Reactor, °F.	912	906	905	906	914	910	905	904
Average Temperature Drop through Catalyst Bed								
Primary Reactor, °F.	86	96	100	99	105	94	87	81
Secondary Reactor, °F.	34	34	36	34	36	36	38	34
Reaction Pressure, psig.	216	222	222	222	230	222	224	226
Space Velocity, Vo/Hr/Vc	0.42	0.42	0.43	0.42	0.44	0.44	0.46	0.45
Reaction Period, Hours	4½	4½	4½	4½	4½	4½	4½	4½
Recycle Gas, SCF/Bbl. Charge	3240	3500	3600	3600	3500	3450	3350	3400
Vol.-% Hydrogen in Recycle Gas	72	78	79	78	79	78	79	78
Naphtha Charge								
Gravity, °API	49.7	49.3	49.9	50.5	51.0	50.9	51.4	51.2
ASTM Distillation, °F.								
IBP	156	183	180	174	157	166	159	153
10%	241	253	250	236	229	231	216	214
50%	320	330	320	311	310	307	294	292
90%	402	410	396	384	385	384	372	375
EP	469	469	455	442	434	430	421	427
Octane Number, CFR-M	39.3	37.4	37.6	39.7	41.5	42.4	45.7	45.3
Aniline Point, °F.	123	126	129	124	124	119	114	113
Bromine Number	3.2	2.7	2.2	2.2	2.0	1.8	2.2	2.3
Lamp Sulfur, Wt.-%	0.309	0.251	0.202	0.220	0.195	0.276	0.310	0.338
Yields, Vol.-% of Feed (Output Basis)								
C_4 Free Gasoline	71.1	72.5	73.5	73.6	71.8	74.2	75.8	75.1
Butanes	12.0	10.5	9.9	10.6	12.0	12.0	12.3	11.9
Polymer	3.0	3.4	3.4	3.2	3.5	3.0	2.1	2.3
Yields, Wt.-% of Feed (Output Basis)								
C_4 Free Gasoline	73.3	74.6	75.8	76.0	74.2	76.5	78.9	77.5
Butanes	8.8	7.7	7.3	7.8	8.8	8.8	9.1	8.8
Polymer	3.9	4.3	4.3	3.9	4.5	3.8	2.6	3.1
C_4 Free Gas	12.1	11.6	11.0	10.7	10.8	9.3	7.8	9.1
Carbon	1.9	1.8	1.6	1.6	1.7	1.6	1.6	1.5
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
Overall Weight Balance, % of Feed	99.2	99.0	96.9	99.2	96.5	97.5	95.6	98.2
Net Make C_4 Free Gas, SCF/Bbl. Charge	732	851	790	748	705	621	549	540
Net Make Hydrogen, SCF/Bbl. Charge	274	....	358	374	312	289	253	199
Gasoline as Produced								
Gravity, °API	50.4	49.8	50.4	50.5	51.4	51.2	51.5	51.6
ASTM Distillation, °F.								
IBP	100	107	102	104	104	102	112	109
10%	149	159	153	156	148	152	156	152
50%	258	267	268	258	253	257	249	246
90%	352	359	349	338	340	341	335	335
EP	407	411	406	399	393	398	396	397
Octane Number, CFR-M Clear	79.7	80.2	79.8	80.3	80.6	80.2	79.6	79.4
+1 cc. TEL	....	....	....	....	....	....	....	....
+3 cc. TEL	....	....	....	....	....	....	....	....
Reid Vapor Pressure	9.4	8.8	8.8	8.9	10.1	10.1	10.2	10.3
Aniline Point, °F.	49	51	54	57	52	49	53	53
Bromine Number	3.4	3.3	3.1	3.2	3.2	3.0	2.7	2.7
Lamp Sulfur, Wt.-%	0.021	0.016	0.014	0.015	0.022	0.028	0.017	0.015
C_4 Free Gas Analysis, Vol.-%								
H_2	37.4	....	45.3	50.0	44.2	46.5	46.1	46.8
CH_4	31.1	....	31.2	21.5	26.7	24.6	28.1	30.8
C_2H_6	17.6	....	13.1	15.4	16.3	15.1	14.9	19.6
C_3H_8	13.9	....	10.4	13.1	12.8	13.8	10.9	12.8
Total	100.0	....	100.0	100.0	100.0	100.0	100.0	100.0
Polymer Gravity, °API	9.7	10.2	11.0	11.1	11.8	11.5	11.3	11.6
C_4 Free Gasoline								
Yield, Vol.-% of Feed (Output Basis)	71.1	72.5	73.5	73.6	71.8	74.2	75.8	75.1
Reid Vapor Pressure**	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0
Octane Number, CFR-M Clear	77.7	78.5	78.0	78.5	78.4	78.0	77.4	77.1
+1 cc. TEL	....	....	83.8	....	....	....	....	83.6
+3 cc. TEL	....	....	86.8	....	....	....	....	87.7
100% C_4 Recovery Gasoline								
Yield, Vol.-% of Feed (Output Basis)	83.1	83.0	83.4	84.2	83.8	86.2	88.1	87.0
Reid Vapor Pressure	11.1	10.3	9.6	9.9	10.9	10.8	10.7	10.5
Octane Number, CFR-M Clear	80.1	80.6	80.0	80.6	80.8	80.4	79.8	79.5
+1 cc. TEL	....	....	86.0	....	....	....	....	86.2
+3 cc. TEL	....	....	89.0	....	....	....	....	90.3
10 lb. R.V.P. Gasoline								
Yield, Vol.-% of Feed (Output Basis)	81.4	82.7	84.0	84.4	82.3	84.8	86.9	86.2
Octane Number, CFR-M Clear	79.8	80.5	80.1	80.7	80.5	80.1	79.6	79.3
+1 cc. TEL	....	....	86.1	....	....	....	....	86.0
+3 cc. TEL	....	....	89.1	....	....	....	....	90.1
Excess or Deficiency of Butane above 10 lb. R.V.P. Gasoline, Vol.-% of Feed (Output Basis)	+1.7	+0.3	—0.6	—0.2	+1.5	+1.4	+1.2	+0.8

* Approximately two-thirds West Texas and one-third Mid-Continent Virgin Naphtha.
** Assumed.

TABLE 5—Data for Hydroformer Runs on Mid-Continent Virgin Naphthas

Run No.	9	10	11	12	13	14	15	16	17	18	19
Kind of Catalyst	Gel	Gel	Gel	Gel	Gel	Gel	Gel	Gel	Low Soda	Low Soda	Low Soda
Age of Catalyst in Stream Days	79	85	89	90	98	56	59	60	117	126	150
Naphtha Coil Outlet °F.	950	913	924	924	989	940	970	970	970	985	1008
Recycle Gas Coil Outlet °F.	1100	1100	1100	1100	1100	1100	1100	1100	1030	1040	1040
Reheat Transfer Line, °F.	975	940	940	940	1000	943	959	957	945	963	980
Average Catalyst Bed Temperature											
Primary Reactor, °F.	913	880	879	880	938	905	922	922	910	916	940
Secondary Reactor, °F.	934	896	895	894	963	911	925	924	899	916	938
Average Temperature Drop through Catalyst Bed											
Primary Reactor, °F.	93	91	88	92	86	131	130	132	111	109	89
Secondary Reactor, °F.	45	53	55	55	39	68	63	55	50	49	41
Reaction Pressure, psig.	230	222	225	225	225	236	238	236	214	217	215
Space Velocity, Vo/Hr/Vc	0.66	0.66	0.83	0.82	0.65	0.53	0.50	0.49	0.44	0.44	0.46
Reaction Period, Hours	6	6	6	6	6	6 2/3	6⅔	7⅓	6¼	6 1/3	7
Recycle Gas, SCF/Bbl. Charge	2980	2520	1805	1830	2950	2500	2640	2650	2940	2890	2780
Vol.-% Hydrogen in Recycle Gas	65.0	73.7	76.0	73.8	53.6	78	76	76	74	73	77
Naphtha Charge											
Gravity, °API	52.6	53.0	53.4	54.3	54.1	53.7	51.5	52.5	52.0	51.9	51.2
ASTM Distillation, °F.											
IBP	218	225	220	212	218	206	212	208	230	238	224
10%	260	258	256	250	253	244	263	250	264	264	246
50%	310	310	304	296	296	302	329	319	306	307	302
90%	370	370	364	356	355	369	378	377	384	387	394
EP	420	412	406	406	402	406	408	412	447	460	462
Octane Number, CFR-M	33.5	34.0	34.0	34.9	34.3	35.4	34.4	34.4	36.4	36.1	35.6
Aniline Point, °F.	....	....	....	....	....	118	171	140	134	132	134
Bromine Number	....	....	....	....	....	....	0.8	1.0	0.4	1.1	0.9
Lamp Sulfur, Wt.-%	....	....	....	....	....	0.021	0.023	0.031	0.027	0.020	0.029
Yields, Vol.-% of Feed (Output Basis)											
C_4 Free Gasoline	76.5	85.6	86.6	86.1	71.4	76.9	74.9	76.3	82.8	79.5	*75.8
Butanes	6.0	3.7	3.4	3.6	6.1	5.6	5.0	5.4	3.5	5.4	6.2
Polymer	2.6	2.2	1.7	1.7	1.7	2.0	3.3	2.5	3.7	3.8	*3.6
Yields, Wt.-% of Feed (Output Basis)											
C_4 Free Gasoline	79.3	87.4	88.6	88.4	74.4	79.2	76.4	78.1	83.6	81.0	77.1
Butanes	4.4	2.8	2.6	2.6	4.6	4.3	3.7	4.1	2.6	4.0	4.6
Polymer	3.3	2.8	2.2	2.1	2.2	2.6	4.1	3.2	4.6	4.8	4.6
C_4 Free Gas	11.5	6.0	5.8	6.1	16.8	12.9	14.6	13.4	8.4	9.3	12.7
Carbon	1.5	1.0	0.8	0.8	2.0	1.0	1.2	1.2	0.8	0.9	1.0
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
Overall Weight Balance, % of Feed	101.6	100.2	96.9	98.8	103.1	99.6	101.6	101.2	100.0	101.0	98.1
Net Make C_4 Free Gas, SCF/Bbl. Charge	1056	751	712	709	1241	1095	911	895	703	713	839
Net Make Hydrogen, SCF/Bbl. Charge	670	556	528	503	660	....	....	....	409	392	442
Gasoline as Produced											
Gravity, °API	49.6	51.4	51.7	51.6	48.4	51.7	50.0	50.1	52.1	51.2	50.5
ASTM Distillation, °F.											
IBP	106	115	120	118	106	119	111	127	120	106	104
10%	176	196	198	198	170	174	165	175	202	182	164
50%	278	285	278	278	268	265	269	265	283	270	250
90%	348	356	352	358	338	343	348	348	346	343	367
EP	406	403	402	426	396	386	393	398	390	416	404
Octane Number, CFR-M Clear	74.5	68.8	66.0	67.8	78.5	74.1	76.6	76.2	69.2	71.4	74.6
+1 cc. TEL	82.0	77.0	76.0	77.0	84.3	....	....	....	78.4	78.9	82.3
+3 cc. TEL	86.7	83.1	82.0	83.0	88.0	85.8	86.1	86.1	83.3	84.1	84.5
Reid Vapor Pressure	4.5	5.4	3.5	3.5	5.2	4.5	5.1	4.9	6.9	6.6	5.8
Aniline Point, °F.	....	....	....	....	....	95	64	87	87	83	76
Bromine Number	....	....	....	....	....	3.1	4.0	4.0	2.1	2.0	1.2
Lamp Sulfur, Wt.-%	....	....	....	....	....	0.001	0.008	....	0.008	0.009	0.005
C_4 Free Gas Analysis, Vol.-%											
H_2	63.5	74.1	74.2	71.0	53.1	....	....	....	58.2	54.9	52.6
CH_4	16.6	13.5	13.0	16.1	21.6	....	....	....	21.3	20.2	19.5
C_2H_6	11.0	6.8	6.8	6.9	14.2	....	....	....	12.9	12.0	13.6
C_3H_8	8.9	5.6	6.0	6.0	11.1	....	....	....	7.6	12.9	14.3
Total	100.0	100.0	100.0	100.0	100.0	....	....	....	100.0	100.0	100.0
Polymer Gravity, °API	12.6	14.3	15.5	15.3	8.9	12.5	11.8	11.4	17.1	13.9	10.7
C_4 Free Gasoline											
Yield, Vol.-% of Feed (Output Basis)	76.5	85.6	86.6	86.1	71.4	76.9	74.9	76.3	82.8	79.5	75.8
Reid Vapor Pressure	1.4	2.9	1.1	1.5	2.6	3.1	3.5	3.4	*2.0	*2.0	*2.0
Octane Number, CFR-M Clear	73.5	67.7	65.0	67.0	77.8	73.7	76.2	75.9	68.3	70.0	73.7
+1 cc. TEL	80.9	75.8	74.9	76.2	83.6	....	....	....	77.4	77.4	81.3
+3 cc. TEL	85.6	81.9	80.9	82.2	87.3	85.4	85.7	85.8	82.3	82.6	83.5
100% C_4 Recovery Gasoline											
Yield, Vol.-% of Feed (Output Basis)	82.5	89.3	90.0	89.7	77.5	82.5	79.9	81.7	86.3	84.9	82.0
Reid Vapor Pressure	6.3	5.8	3.8	4.3	7.6	7.5	7.4	7.6	4.9	6.3	7.0
Octane Number, CFR-M Clear	75.0	68.8	66.1	68.2	79.1	75.2	77.4	77.1	69.4	71.6	75.4
+1 cc. TEL	82.6	77.0	76.1	77.5	85.0	....	....	....	78.6	79.1	83.2
+3 cc. TEL	87.3	83.1	82.1	83.5	88.7	87.0	87.0	87.1	83.5	84.3	85.4
10 lb. R.V.P. Gasoline											
Yield, Vol.-% of Feed (Output Basis)	88.1	95.7	99.6	98.7	80.2	86.2	83.7	85.3	93.8	90.4	86.5
Octane Number, CFR-M Clear	76.3	70.5	68.8	70.6	79.7	76.0	78.2	77.9	71.5	73.0	76.4
+1 cc. TEL	84.1	78.9	79.1	80.1	85.7	....	....	....	80.8	80.7	84.3
+3 cc. TEL	88.8	85.0	85.1	86.1	89.4	87.9	87.9	88.0	85.7	85.9	85.5
Excess or Deficiency of Butane above 10 lb. R.V.P. Gasoline, Vol.-% of Feed (Output Basis)	—5.6	—6.4	—9.6	—9.0	—2.7	—3.7	—3.8	—3.6	—7.5	—5.5	—4.5

*Assumed.

TABLE 2—Comparison of Motor and Research Octane Numbers for Hydroformed Gasolines as Produced

Run No.	17		18		19	
	CFR-M Octane	CFR-R Octane	CFR-M Octane	CFR-R Octane	CFR-M Octane	CFR-R Octane
Clear	69.2	74.9	71.4	77.1	74.6	80.7
+0.5 cc. TEL	...	79.7	...	81.9	...	84.5
+1.0 cc. TEL	78.4	83.1	78.9	85.4	82.3	88.0
+2.0 cc. TEL	81.3	87.0	82.6	88.5	84.0	90.6
+3.0 cc. TEL	83.3	89.0	84.1	90.7	84.5	91.5

increase from 0.7 to 1.7 wt.-% over the same octane range.

6. Effect of Heavy Naphtha Feed Stocks—There is one interesting point which cannot be shown on the plots. This concerns the effect on yield of 400° F. end-point gasoline of raising the end-point of the naphtha feed. It has been the usual practice to charge a naphtha with an end-point very little above that desired for the gasoline product.

During three of the Mid-Continent runs, however, the naphtha charge had an end-point averaging 456° F. with over 7 vol.-% boiling above 400° F. It might be expected that most of this high-boiling material would appear in the polymer resulting from cutting the gasoline product at 400° F. end-point. Actually, however, only 2% more polymer, based on feed, and with no increase in gas or carbon, was made in these operations than in those where 400° F. end-point material was charged.

It is concluded, therefore, that the balance of the heavy material was broken down into 400° E.P. gasoline. Confirming this belief, a similar high-boiling naphtha was charged in some of the West Texas-Mid-Continent runs with an even smaller proportion of it showing up in the polymer. These findings are of interest to the refiner since they indicate that petroleum fractions boiling in the 400-500° F. range can be converted into 400° E.P. high-octane gasoline with relatively good yields.

Desulfurizing of Sour Naphthas

Table 3 presents the results of one typical run on a mixed feed consisting of approximately two-thirds West Texas virgin naphtha and one-third Mid-Continent virgin naphtha.

Notice that over 93% of the sulfur has been removed and that the octane value of the naphtha has been improved over 40 points to a level of 80.3 without the addition of tetraethyl lead. The bromine number of 3.2 indicates a practically olefin-free stable product, while an aniline point of 57° F. indicates the presence of a high percentage of aromatic material, which is known to contribute to the anti-knock characteristics of gasoline.

Tables 4 and 5 show the original and calculated data for all Hydroformer runs discussed in this paper. (See pages R-463 and R-464.)

TABLE 3—Results of Hydroforming a Mixed Feed of West Texas and Mid-Continent Virgin Naphtha

	West Texas and Mid-Cont. Mixture	Hydroformed Gasoline
Gravity, °API	50.5	50.5
ASTM Distillation, °F.		
IBP	174	104
10%	236	156
50%	311	258
90%	384	338
EP	442	399
Oct. No., CFR-M Clear	39.7	80.3
Lamp Sulfur, wt.-%	0.220	0.015
Aniline Point, °F.	124	57
Bromine Number	2.2	3.2
Yields, Wt.-% of Feed (Output Basis)		
C_4-Free Gasoline	76.0	
Butanes	7.8	
Polymer	3.9	
C_4-Free Gas	10.7	
Carbon	1.6	

High Yield and Gasoline Quality

Although the yield and product characteristics described above have not been compared with those of any other method of naphtha upgrading, the worth of Hydroforming becomes very evident when the process is compared with the older thermal reforming technique.

For example, if a West Texas heavy naphtha with a 44-octane rating is processed to the same yield by both method of naphtha upgrading, the worth show an octane advantage of from 5 to 7 points over the thermally reformed product. And when the same naphtha is processed by both methods to produce a 75-octane gasoline the yield by Hydroforming is 89.6% as against 84.2% for thermal reforming.

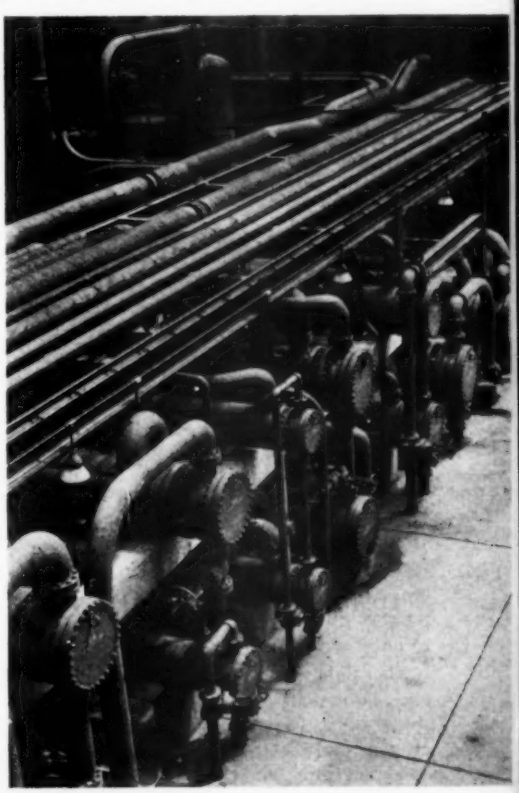
To make the comparison even more convincing the yield figures by Hydroforming, from a practical standpoint, are even higher inasmuch as the low vapor pressure of the end product permits the addition of excess butanes which may be available from other refinery operations. (See Fig. 4 and 6 and earlier text on yield-octane relationships).

Today, with the increased trend toward the use of catalysis in improving quality and yield of gasoline, the desirability of the Hydroforming reaction is indicated wherever the problem of utilizing low-grade napthas exists. Economically, the indications are that this process will be even more attractive in the future because of decreased investment costs and improvement in catalyst and operating efficiency in units being developed.

The authors wish to acknowledge the generous cooperation of the following companies who furnished product and operating data from their Hydroforming units: Continental Oil Co.; Pure Oil Co.; Standard Oil Co., (Indiana); The Texas Co.

CORRECTION

In Table 7, pg. R-370, May 1st NPN TECHNICAL SECTION, in the article "Crude Desalting in Refinery Operations," the heading of the third column incorrectly reads "Water LV%." It should read "LV%."



A view of the Transformer Line Exchanger system of a hydroformer installation. Here heat is transferred from the hot reaction products to incoming naphtha feed and recycle gas. All of the heat required to operate the fractionating system is obtained from the hot product gases. All the heat exchangers except the waste heat boilers are concentrated near the fractionating towers for ease of construction and convenience of maintenance

PERSONALS

Petroleum Technologists in the Headlines

Frank C. Fowler has been appointed assistant professor of chemical engineering at the University of Oklahoma. For the past three years Dr. Fowler has been employed in the chemicals products department of the Phillips Petroleum Co.

° ° °

C. R. Nelson, Shell Development Corp., San Francisco, is general chairman in charge of the program of the convention of the American Institute of Chemical Engineers in San Francisco, Aug. 25-28. **George C. Jester, Jr.,** California Research Corp., Richmond, is in charge of arranging plant visits. Theme of the A. I. Ch. E. meeting will be "New Chemical Industries of the West". A symposium on chemicals from petroleum is being scheduled.

° ° °

E. R. Rowzee, research director of Polymer Corp., Sarnia, Ont., the Canadian government's synthetic rubber plant, has been appointed director of marketing and research. He will be in charge of domestic and export sales promotion and of supplying technical assistance to manufacturers, and of research. Mr. Rowzee graduated from Mass. Institute of Technology in 1931 and, in the rubber field, pioneered in the development of synthetic rubber. He went to Canada in 1942, at the request of the Canadian government, to manage the Buna-S unit of Canadian Synthetic Rubber Ltd.

° ° °

T. P. Sands, lubrication engineer, Gulf Research and Development Co., Pittsburgh, has been appointed automotive engineer in the research department of Monsanto Chemical Co.'s Organic Chemicals Division. He will be specifically responsible for the technical coordination of petroleum chemicals evaluation. Mr. Sands graduated in mechanical engineering at Iowa State College in 1933 and for the past 10 years has been with Gulf, where he did considerable work in the evaluation of lubricant compositions.

° ° °

Charles P. Baker has been promoted to the position of general superintendent of the East St. Louis refinery of Lubrite Division of Socony-Vacuum Oil Co., Inc. Since Jan. 1 he had been assistant to W. H. Montgomery, refinery manager. He was formerly technical adviser to the Operating Department of the Beaumont refinery of Magnolia Petroleum Co., prior to entering the armed services.

Mr. Baker entered the Army as second lieutenant in 1942. His services were later requested by P.A.W. and, after advancing to the rank of major, he became Chief of the P.A.W. Aviation Section. He received his degree in chemical engineering at Texas A. & M. University in 1934 and on leaving school was employed by the Magnolia company.

° ° °

Lloyd F. Bayer, vice president of the Associated Division of Tide Water Associated Oil Co., has been relieved of responsibility for the management and operation of the manufacturing department, to concentrate on his activities as chairman of the operating committee.

Herschel Y. Hyde has been appointed vice president in charge of manufacturing. **V. P. Hugo,** who continues as manufacturing manager, was appointed an assistant vice president.

T. O. Edwards, Jr., general superintendent of the Associated's Avon refinery for more than 8 years, has been made general manager there. **C. K. Viland** was promoted to general supervisor of the research and development department, succeeding Mr. Hyde.

° ° °

George G. Pritzker, formerly patent examiner in the U. S. Patent Office, on June 1 became associated with Shell Development Co., San Francisco, as a member of the Petroleum Technology Division of the company's Patent Department.

Mr. Pritzker

Mr. Pritzker has written a number of articles on petroleum patents, including a series of three on "Lubricating Oil Additives," published last fall in the NPN TECHNICAL SECTION and recently reprinted in pamphlet form. He received his degree in chemical engineering from Brooklyn Polytechnic Institute and then went to work for the Freeman Chemical Co. in Detroit, working on highly specialized oils and greases.

Since September, 1942, he has been with the U. S. Patent Office examining patent applications on various lubricating compositions and lubricating oil additives.

° ° °

E. K. Anderson, El Dorado, Kans., has been promoted from superintendent at the El Dorado refinery of Skelly Oil Co. to manager of refining with headquarters at Tulsa. He will eventually assume charge of operations for the refineries at Longview, Texas, and Denver. The move is being made to coordinate all refining operations under a single head in the interests of efficiency and to relieve the load on Manager G. E. Canaday.

Justus O'Reilly, Tulsa, special assistant to J. W. Vaiden, vice president in charge of manufacturing, will succeed Mr. Anderson as superintendent at El Dorado.

Other departmental shifts by Skelly include: **Howard Belew** to assume much of Mr. O'Reilly's work on economics, cost and yield analysis; **J. Y. Haslam,** El Dorado, from resident engineer to chief engineer for the refining division; **C. E. Gore,** El Dorado, from assistant superintendent of lubricating and grease plants to superintendent; **Paul Bartholow,** El Dorado, from grease plant foreman to assistant superintendent under Mr. Gore.

° ° °

A. H. Calderwood, former manager of the Wilmington, Calif., refinery, has been appointed manager of the manufacturing department in the San Francisco head office of Shell Oil Co., Inc. He replaces **Dr. Monroe E. Spaght,** whose appointment to vice president of Shell Development Co. was announced recently. **R. W. McOmie** succeeds Calderwood as manager at Wilmington refinery and **L. R. Goldsmith** takes McOmie's place as superintendent of the Southern California plant. Shell's huge wartime expansion of Dominguez, including construction of the catalytic cracking plant and the toluene plant, was carried out under Mr. Calderwood's management.

° ° °

Joseph E. Bludworth has been appointed director of petroleum chemicals research and development for the Celanese Corp. of America, Bishop, Tex. **Kenneth D. Bowen,** formerly with Dow Chemical Co., has been appointed plant manager.

° ° °

John Jacob Brown, chairman of the boards of Foster Wheeler Corp., and Foster Wheeler Ltd. of Canada, died recently at a New York hospital. He was 73. Mr. Brown was a native of Tyler, Texas, and entered business as a construction engineer in 1895. He became vice president of Wheeler Condenser and Engineering Co. in 1907 and president in 1918. He became chairman when the present company was formed through a merger. During World War I he was a member of the condenser committee of the War Industry Board.

° ° °

Thomas A. Terry, Jr., has joined the processing engineering department of the Baton Rouge, La., refinery of Standard Oil Co. of New Jersey, Louisiana division. Terry was with the research and development department of the refinery from 1937-39, and was recently released after 46 months of Army service.

Waste Oils Escaping to Surface Waters May Cause Many Kinds of Damage

Article 6 in a Series—By W. B. Hart

In charge of Waste Disposal for Atlantic Refining Co.

When waste in the form of oil reaches surface waters, or even soil adjacent to a refinery, several types of damage may result.

Water used for cooling purposes by the plant itself may be contaminated.

Storm-water wastes may overflow the disposal plant and the oil thus escaping contaminate nearby waters and nullify the results of previous waste treatment.

Fire hazards to piers and buildings may result from sludgy layers of oil on the water, which may also cause corrosion damage to steel structures.

Not the least damaging effect, films of oil and layers of oil sludge are detrimental to fish and game life, and also affect the recreational use of waters.

THE general characteristics of refinery wastes were described in an earlier article in this series. To provide for a clear understanding of the effects of these wastes upon surface waters, the characteristics of these waters have also been described. The effects of various refinery wastes upon surface waters will now be considered, in the order in which the wastes appeared in Table 1, Article 4 in the series.*

At all times, when thought is given to the effects of refinery wastes on surface waters, and treatment processes are discussed, it should be borne in mind that the absolute values of the acting forces usually are small, and in some instances almost minute. Pronounced toxicity has been demonstrated by low concentrations of various substances present in refinery wastes.

Experience has shown that the importance given to waste treatment and disposal of small forces and low concentrations often is difficult for the refinery personnel to understand. Frequently this lack of comprehension has been the major factor in treatment and disposal problems. This factor will be emphasized in later discussions.

Uncontaminated Surface Waters

It is obvious that if the source of water for a refinery is an adjacent body of surface water and in the use of the water it is uncontaminated, its return can have little effect upon any characteristic of the surface water. If this condition were universal, the matter of waste water disposal could be dismissed at once. But it is far from universal and even when waste waters are chemically uncontaminated they can and do affect the surface waters. They affect to some degree the temperature, dissolved oxygen content, biochemical oxygen demand and even the toxicity.

Temperature — Any effect of wastes upon the temperature of surface waters is one of averaging. Refinery waste waters, as discharged, usually range in temperature from 85° F. to 115° F. Some surface waters have temperature ranges (seasonal or otherwise, depending upon location) greatly in excess of this, but with upper limits usually below or not much above the lower temperature limit of the waste waters.

Thus, when the wastes are discharged into surface waters of lower temperature, and the volume of the surface water is not sufficiently great to quickly reduce the waste water temperature, an increase in the temperature of the surface water will result. This may or may not be important, depending upon the magnitude of the effect and the use made of the surface waters. Obviously, it could greatly reduce the value of such waters for cooling purposes.

Increased temperature, if sufficiently great, can also affect aquatic life seriously. Most forms of aquatic life have upper and lower temperature limits defining a relatively low range outside of which they cannot live. For this discussion the lower temperature limit is not important, but the upper limit is. Heilbrunn[40] tabulates many upper temperature limits, and the sources of the data. Upper limits for forms of aquatic life important in waste disposal problems are shown in Table 1.

It should be remembered that these maximum temperatures shown are lethal after an exposure of relatively few minutes. Unless care is exercised, temperature effects can be destructive to life forms important to stream self-purification and cleanliness.

Dissolved Oxygen — Water which is used for cooling only, and which ordinarily is regarded as uncontaminated, usually is of low dissolved oxygen concentration when discharged, or is entirely devoid of oxygen. This is caused partly by the lower solubility of oxygen at the more elevated temperature of the discharge, and partly by the increased activity of bacteria in the cooling water. These bacteria cause the oxidation of organic matter either in the water or in the cooling system, and as a result the

TABLE 1—Lower and Upper Temperature Limits for Forms of Aquatic Life Important in Waste Disposal Considerations

Form	Limits, °C.	Limits, °F.
Bacteria	40 to 44	104.0 to 111.2
Algae	28 to 30	82.4 to 86.0
Water molds	33 to 35	91.4 to 95.0
Larger aquatic plants	45 to 55	113.0 to 131.0
Various protozoa	35 to 40	95.0 to 104.0
Worms and similar forms	25 to 40	77.0 to 104.0
Mollusks Arthropods	22 to 55	71.6 to 131.0
Insects, including larvae	35 to 60	95.0 to 140.0
Fishes and amphibians	24° to 35°°	75.2° to 95.0°°

° Cold water families.
°° Warm water families.

*NPN TECHNICAL SECTION, April 3, 1946, pg. R-295.

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dissolved oxygen originally present in the cooling water may be consumed entirely.

The effects of waste water discharge upon dissolved oxygen may be confined to the vicinity of the drainage outlet, if there is sufficient surface water available to supply dissolved oxygen to the waste water as it is discharged. The concentration of oxygen dissolved in the mixture should rise quickly to above 40 to 50% of saturation, even though none is preset in the waste. If this does not happen, no aquatic forms can live in the mixture. The waters recover rapidly after there has been sufficient flow or agitation to permit absorption of enough oxygen for aquatic life of re-establish itself.

Biochemical Oxygen Demand — As mentioned above, bacterial action usually increases with elevated temperatures, within limits comparable to those ordinary to refinery cooling water discharges. This increased bacterial action, if oxygen is present, tends to bring about oxidation of organic matter as the water passes through the cooling system, and thereby reduces the biochemical oxygen demand. This occurs at the expense of the dissolved oxygen content. By such action the biochemical oxygen demand, which in clean surface waters is of the order of fractions to one or two parts per million, may be reduced materially, or practically eliminated. This, however, is a desirable feature.

Toxicity — Any discussion of toxicity under a heading of "Uncontaminated waste water" may seem incongruous. Such is not really the case. For example, some surface waters are corrosive to a degree which results in their picking up heavy metallic ions as they pass through the cooling system. This can be serious only if it results in concentrations in the surface waters which can be harmful to aquatic life. These concentrations will be considered in greater detail later.

Storm-water Waste

When storm-water flows into surface water directly, it carries with it a variety of substances washed or flushed from the surface of the ground. If these substances are potential pollutants, a temporary pollution may result.

When storm run-off water flows to plant sewers leading to waste treatment plants, these plants, unless they have been designed for sufficient capacity, will be overloaded. As a result, the wastes they have been designed to treat may pass through unaffected and reach and contaminate the receiving surface waters. Oil from leaks and spills frequently is carried into surface waters in this manner.

Two features are important to bear in mind when storm water run-off flushes the surface of the refinery area and overloads the treatment plants. The first of these is that when such a heterogeneous mass of substances reaches the surface

waters there is no way of predicting what the effects will be. Under such circumstances it is difficult to know what waste has caused damage to the surface waters, or what corrections may be taken.

The second, and the most important feature, is the extent of the damage which may result. A refinery may have spent thousands of dollars on waste treatment and disposal. As a result, the surface water being protected may have been brought back from a highly polluted state to one of cleanliness and general usefulness. Then, as a result of the escape of pollutional substances with storm run-off, the surface waters can be set back for years in the course of an hour or so. All aquatic life can be destroyed, dissolved oxygen eliminated, and further uses of the water affected. It may take several years for the waters to recover.

Oil and Oily Wastes

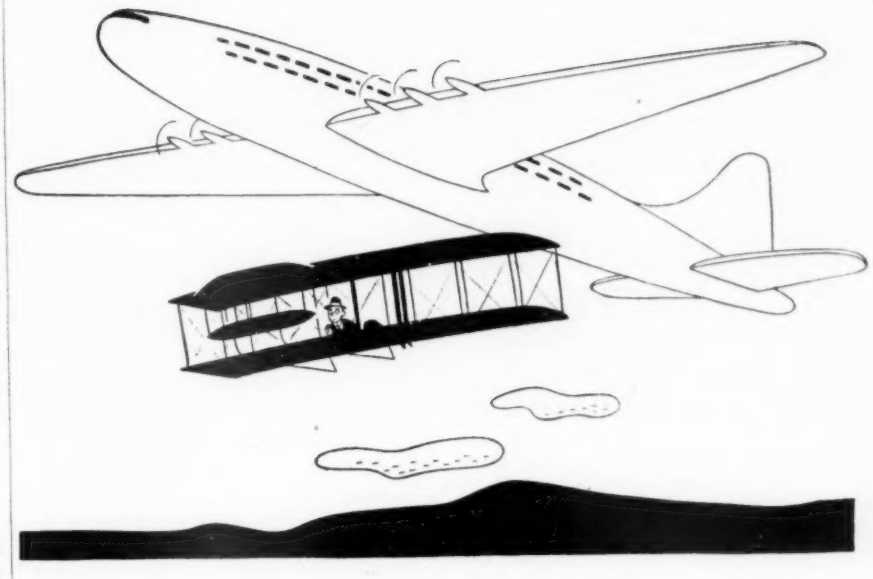
Oil may be spilled upon either land or water, or may be spilled upon land and flow to some body of surface water. The effects depend largely upon the characteristics of the oil and the characteristics of the ground.

The first effect is the vaporization of some of the oil, which is affected by the oil viscosity, type of soil, and temperature. A very light oil spilled upon hard, sun-baked ground may evaporate almost completely. Heavier oils evaporate less completely but, if not too viscous, penetrate the soil. Even compact clay will be penetrated to some degree. The penetration into usual top soil is extensive, although some of the oil spilled often remains as a pool on the ground. Heavy oils, such as bunkers, neither evaporate nor penetrate even relatively porous soils to any considerable extent, nor do they flow readily unless the warmth of the sun or the soil reduces the viscosity sufficiently.

Even light oils coat and kill any vegetation which they contact for any length of time. Various plant forms caught by the penetrating oil also are destroyed, and some of these are vitally important to soil productiveness (Schmidt and Wilhelm[55]; Carr[56]; Murphy[57]; Baldwin[58]).

Oil which continues to penetrate the soil as long as surface pools are permitted to stand, is lasting in its effects. It compacts the soil particles and prevents the penetration of air. It coats the particles and interferes with the distribution of water. Evaporation continues to remove the lighter portions of the oil until only heavy residue is left.

Soil bacteria start their recovery action on this residue which has been gradually made more accessible through the effects of rains which eventually penetrate the affected area. Later other earth forms enter into this recovery action and accelerate the return of the soil to its normal condition of productivity. The entire period from spill to recovery, however, may require several



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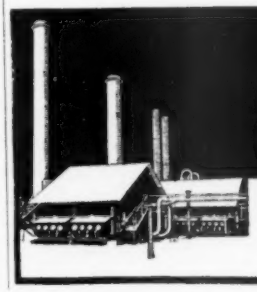

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years if the spill is heavy, unless the soil is turned over by ploughing or otherwise. During this time the soil will grow little or nothing. Continued spills or other escapes of oil over the area can prevent any growth forever.

Readers who desire to study in detail why plants and lower animal forms are destroyed when coated with oil will find their processes of respiration, transpiration and photosynthesis discussed by Transeau, Sampson and Tiffany[59] and Welch[47].

Of all the animal forms which live in the upper levels of the soil the earthworms are the best known and probably the most important[60], [61]. One of the physiological characteristics of earthworms is that their respiration takes place through the entire surface of the body. Thus they are highly vulnerable to oil which penetrates the soil. It coats their body surface, respiration stops, and they die. Since they are highly important to soil aeration, and contribute to its nitrogen content, even the bacterial correction of the degraded soil is retarded by their destruction. Other important animal forms are affected similarly.

Limits on Oil Penetration

The extent to which oil can penetrate the soil is limited usually only in a vertical direction. This limitation is established by the level at which the subsurface water occurs, commonly known as the "water-table." This level varies in different regions and during different seasons. Sometimes the water-table is quite deep (Toland[62]).

Oil which penetrates the ground is not very viscous, for among other factors relatively low viscosity is essential to penetration. When the oil comes into contact with the water-table its downward movement is stopped and the same factors impel lateral movement. For this reason (i.e., that both downward and lateral movement occurs), a whole subsurface region can become impregnated with oil. Its vapors can penetrate the formation even ahead of the oil body, and accumulate in nearby basement structures, wells, and so forth. Fire and explosion hazard are created frequently by this gas movement.

Oil which flows over the ground or reaches surface waters in some other manner affects these waters, their uses and the aquatic life they support in various ways. These effects can be explained with greater clarity if the oil is followed to its ultimate destruction.

First consideration will be given to the escape of relatively light oils, such as gasoline or gasoline stocks. Such oils will spread rapidly over the water surface and simultaneously much of it will evaporate. During this period the major effect is the serious fire and explosion hazard which exists for life and property wherever the vapors travel until they are so diluted by air that they no longer are combustible. A film of so-called "heavy ends" remains on the water. This film is subject to various forms of attack tending to destroy it.

Winds exert a great influence on oil films or layers floating upon water and will cause the oil to travel with them even in opposition to relatively high surface current. Winds also create wave action, which gradually breaks the film into patches. Any floating debris is captured in the film unless it is too large and heavy to be subject to the surface tension. This action also tends to draw the film into patches, often with the debris acting as what might be termed a nucleus.

Regardless of how the oil film patches are formed, they continually pick up dust from the air and particles of silt or other suspended matter from the water, to an extent that gives the mass a sludge-like consistency and usually a density greater than that of water. Any reduction in temperature contributes to this increase in density. When the density of the aggregate finally exceeds that of the water the mass sinks to the bottom.

Should the patches or film encounter some indentation in the shore contour, or some barrier which rises out of the water, the oil may accumulate and form a heavy film, or even a layer of oil on the water. This layer, which will be much thicker than the original film because of the pressure of winds and waves holding it in the trap-like space, will resist disruption for days or even weeks unle through some effect of current it is carried out into open water. Evaporation, the action of bacteria, and perhaps direct oxidation, will reduce any remaining layer so that it also films and eventually is broken up, and through accumulation of dust and silt the individual patches sink to the bottom.

How Oil Films Disappear

The disappearance of oil films along a regular, natural shore line of a lake offers a good example of the general processes which cause oil films to disappear from water surfaces. In even calm weather wavelets are formed along such a shore because of bottom drag, and fine particles of sand are churned up. The film is broken into patches by the same wave action. The sand and oil mix and aggregate. The aggregates then sink. Even though there may be an extensive film offshore, a relatively clean area will extend along the shore. It may be narrow or fairly wide, depending upon the slope of the lake bottom. The less the slope (i.e., the shallower the water) the wider will be the clean area.

Films on open water, when they have been reduced in thickness to approximately 0.00004 in., which may require several days in the case of bunker oils, also disappear rather rapidly, usually in less than a day. Laboratory experiments indicated that very thin films, 0.000003 in. or less in thickness, disappear from moderately agitated water surfaces in but a few hours, the very fine dust particles causing the film to draw into patches and sink.

TABLE 2—Approximate Thickness and Appearance of Oil Films*

Approx. Thickness, in.	Appearance
0.0000015	Barely visible under favorable light conditions.
0.0000030	Visible as silvery sheen.
0.0000060	First trace of color visible
0.0000120	Bright bands of color visible.
0.0000400	Colors begin to turn dull
0.0000800	Colors much darker.

* These data from "Manual for Disposal of Refinery Wastes" Part I. The American Petroleum Institute.

Difference Between Films, Layers

It is convenient in considering waste disposal problems to distinguish between oil films and layers. Oil films may be defined as very thin layers on the water surface which range from those so thin as just to be discernible to those just too thick to cause diffraction of light rays, and which separate white light into its component colors (i.e., cause iridescence).

The approximate thickness of such films is shown in Table 2.

Oil layers are definite layers. When lubricating oils, heavy fuels and so forth escape and spread over surface waters they do not form layers as rapidly as light oils form films. Viscosity (indirectly, temperature), density, surface tension, and other factors such as suspended matter and debris in the water, play a part in establishing the rate of spread. There is some evidence that in general the rate of spread varies as the reciprocal of the product of the density and the kinematic viscosity, but this is not well established. Stroop [63] investigated the rate of spread and the disappearance of bunker oil on the ocean off the Hawaiian Islands and off New York Bay.

Layers of heavier oils eventually sink to the bed of the surface waters, the same as light oil films. Either the layers are broken up before they spread further and become films, or they gradually spread and film to a thinness which permits wave action or water traffic to break the film into patches. These eventually sink when they become dust or silt laden. Little of the oil disappears as a result of evaporation. This can be established by a comparison with the evaporation rate of water, using the vapor pressure of the water and of the oil as a basis.

The final disappearance of oil takes place by bacterial action in the ooze or sludge on the bottom (Zobell, [64]). There is some action at the surface, but usually not to the extent that occurs on the bottom. Here the bacteria destroy the hydrocarbons by an oxidizing, biochemical process, obtaining the oxygen from the water, or from oxygen-containing salts.

Much of the investigation of the utilization of hydrocarbons by bacteria has been conducted as a part of the studies

of marine bacteria. ZoBell, Grant, Haas, Bushnell, and Novelli [64, 65, 66, 67, 68, 69] have contributed to the recent literature and accumulated an extensive bibliography. Space does not allow for a summary of this work.

Oil does not disappear from the surface of either inland or marine waters before it causes damage. In surface films or layers it has several effects. It accumulates on structures as a sludgy layer, resulting from the dust, silt and other rather finely divided debris which it collects. Such layers not only are unsightly but serve as an environment for bacterial action which often is detrimental to the structures. Oil impregnated wood presents a serious fire hazard. The sulfur compounds in oils which accumulate on steel and concrete are reduced to elemental sulfur which in turn is oxidized to sulfuric acid and acid corrosion follows.

Several species of bacteria are capable of reducing sulfates. Sulfur is liberated and hydrogen sulfide is produced, depending upon the environmental conditions [66, 69, 70, 71, 72]. Other forms convert sulfur and hydrogen sulfide to sulfuric acid [67, 70, 73], the *Thiobacilli* being an important example. Any or all of these bacteria may be active in sludge-like deposits on steel and concrete shore-line structures and may cause serious corrosion. This corrosion, and the fire hazard, are the major effects of floating oil on shore-line installations, although paints and other coatings may be affected directly or indirectly by liberated hydrogen sulfide.

Effect on Natural Shore Lines

Natural shore lines (i.e., undeveloped) are affected in a different manner which concerns principally the aquatic life in the surface waters. Both plant and animal life are damaged. Emergent vegetation (i.e., that rooted in the bottom and extending above the water surface) becomes coated and soon dies. The dead plant tissue sags, sinks into the water, and decays. This dead tissue is added in the water to the organic matter which must be oxidized, i.e., increases the biochemical oxygen demand.

When the vegetation is destroyed, the protection it affords the young of various valuable fish is gone, and the young fish become easy prey for less valuable predator forms. All fish may be, and often are, damaged because the oil coats their gill tissues and interrupts the exchange of oxygen and carbon dioxide. Both young and mature fish then die by asphyxiation. Eggs and larvae of fish are killed when they become coated with oil (Gutsell [74], Wiebe [75]). Many forms of aquatic life, algae, protozoa, larger animal forms such as the water fleas (*Daphnia*), are killed under similar conditions. Even thin films of oil can cause death. Shore line aquatic life has been discussed by Fassett [76], Needham and Lloyd [53], Wipple [49], and Ward and Whipple [54], and its importance to

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stream self-purification has been explained.

Films of oil on open waters also are destructive to a variety of valuable fish and their food. Species of fish either feed at the surface or in their various habits "break" the surface of the water. If, in so doing their gills become coated they generally die, although some strong specimens flush the oil away and recover.

Many microscopic and macroscopic animals and plants live at or near the water surface and others migrate to the surface daily [44, 47]. These plants and animals are the food of the fish and are readily susceptible to destruction by floating oil. When the food disappears the fish soon leave.

When layers of oil sludge form on the shore line bottom, the nests and eggs of some of the most valuable fish, the basses and sunfish, are destroyed, for it is the habit of these fish to nest in shallow shore waters on clean bottoms. Many varieties of fish habitually come from deeper waters to the shallow shore waters to feed upon various bottom living animals and upon those which fall into the water from shore vegetation. As examples there are the worms such as tubifex and the flat worms [77, 78, 79], the naiads of dragon-flies, stone-flies and May-flies [80]. None of these food forms, nor shellfish such as oysters and so forth, can live when a blanket of oily sludge covers the bottom of the surface waters [81].

Shore Line Erosion Also Results

A shore line degraded by floating oil layers is unstable. Plants on the banks are killed by the oil which penetrates the ground and coats the roots. If this condition becomes general the roots of all vegetation in the zone decay. These roots are highly effective as the stabilizers which enable the banks to withstand erosion. When the roots no longer are able to function as retainers of the soil, wind and wave action, run-off storm waters, and other accompanying conditions all contribute to erosion. Banks may collapse and shore indentations enlarge, and the erosion may be propagated to removed inland areas, considerably far from the shore proper, causing the land value to suffer.

Recreational activities are affected seriously by oil. Ocean-side beaches, where bathing is a prominent activity, have suffered from oil being washed in from the sea. Shore wildlife, and finny and shell fisheries all have been adversely affected by oily sludge which has sunk to the bottoms offshore [82, 83].

One of the effects of heavy oil pollution has been the destruction of thousands of aquatic and shore birds, the greatest loss occurring among ducks during migration [84].

Oil contributes taste and odor to water which at times has carried through water purification plants and caused criticism of the supply. One taste effect is that contributed to the flesh of fish and other aquatic foods by oil. Various degrees of oil pollution are claimed to be necessary to cause this condition. This matter needs considerably more investigation before it can be evaluated even approximately.

Finally, crude oils contain soluble components which are toxic. When crude oils and residuals escape and reach surface waters the toxic components are leached out and affect the waters so that they are toxic to aquatic life [75, 81]. Distillates do not seem to carry these toxic components, at least not in degree to produce significant effects.

In past years there has been much discussion of the effect of floating oil on the gaseous interchange between the water and the atmosphere. It is undoubtedly true that a layer of oil on quiet water, and covering the entire surface, will seriously interfere with gaseous interchange. But, as has been mentioned earlier, the aeration of water is much more dependent upon wind and wave action, and photosynthesis, than upon absorption from the air. Wind and wave action, as already mentioned, cause the breaking up or segregation of the oil layer, leaving open water through which oxygen can be absorbed through the agitated water surface. Light also passes these openings to reach the green plants. It would seem that this effect of oil pollution has been overemphasized.

The effects of oil which have been discussed are those of "free" (i.e., unemulsified) oil. Some other effects are equally important under localized conditions. Among these should be mentioned the adverse effect of oil which enters certain types of sewage treatment plants, in any considerable quantity, particularly activated sludge plants. There has also been a discussion of the effects of road surfacing materials. Storm water which ran off from these roads, it was claimed, caused tastes in drinking water. The work of Carpenter [85] and others has proved that road surfaces made from petroleum products such as asphalts do not contribute taste to water.

Emulsions of oil and water present some additional effects. These, and the effects of other refinery wastes will be considered in the next article.

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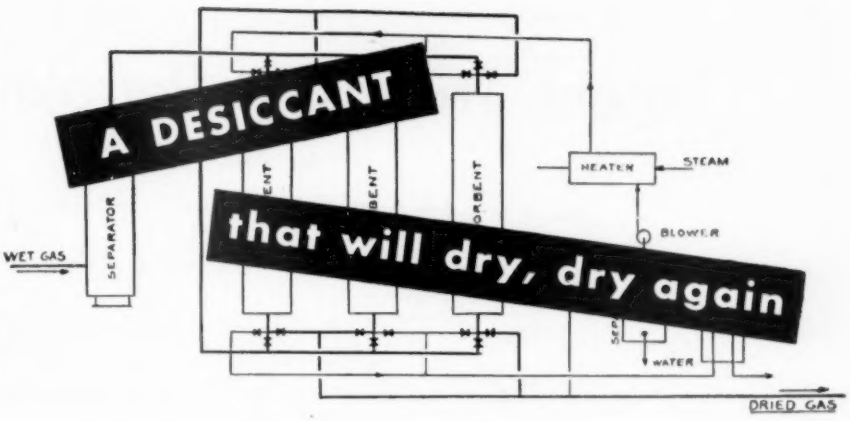

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Patent Attorney and Editor "The Technical Survey"

Lubricants

Extensive work by California Research Corp. has led to a series of patents (U. S. 2,398,414-6) on the use of various **selenium and tellurium compounds as antioxidants in lubricating compositions.** This firm first developed a practical method for producing highly soluble organic compounds containing these elements and found them decidedly superior to corresponding sulfur compounds.

As can be seen from Table 1, dicetyl sulfide was least effective, while dilauryl diselenide ($C_{12}H_{25}Se_2C_{12}H_{25}$) was the most effective of the selenium compounds tested in the base oil (SAE 30 Western) employed. Data show the superiority of diparaffin selenide and dicetyl telluride as judged by the Dornte oxygen absorption test. Other data show the effect of dilauryl selenide concentration upon piston discoloration and ring clogging in Lauson engine runs on Western SAE 60 aviation base containing 0.375% sulfurized calcium cetyl phenate and 0.125% sulfurized calcium cetyl phosphate. Bearing corrosion data showed excellent superiority of these additives.

In the case of dicetyl sulfide, the patents point out that this compound is not a very potent inhibitor if it is the only inhibitor in an oil, but if an "activator" such as calcium cetyl phosphate is present, the combination forms a potent antioxidant. Surprisingly, the dialkyl selenides do not behave in the same manner. They have been found to be potent inhibitors when acting alone. In the absence of iron, cetyl selenide is more effective in the absence of calcium cetyl phosphate, than in its presence, whereas, in presence of iron, dilauryl selenide is more effective in presence of calcium cetyl phosphate than in its absence.

Development work by a West Coast oil company in the use of selenium and tellurium compounds as antioxidants in motor and other lubricating oils is disclosed in recent patents. They have been found superior to the corresponding sulfur compounds.

Another company has demonstrated the superior qualities of certain silicone fluids as hydraulic fluids. An oil company employs the bottoms from the distillation of alkylates as bases for hydraulic fluids and special lubricating oils.

In an entirely different field, a process has been developed for the recovery of cresols from spent caustic in gasoline sweetening operations; patent has been applied for.

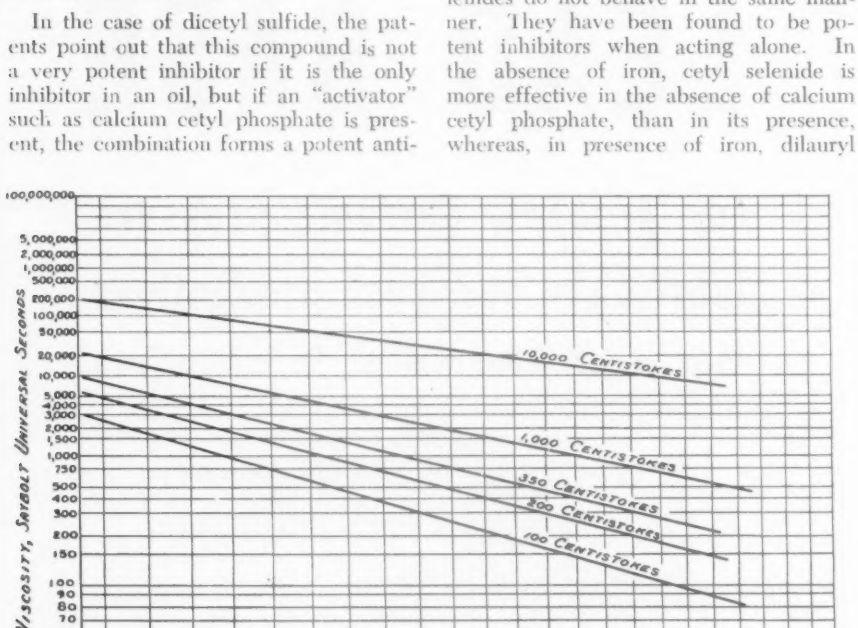

Fig. 1—Viscosity-temperature chart of high polymeric dimethyl silicone fluids of different intrinsic viscosities

In the field of **non-soluble cutting oils**, Standard Oil Co. (Ohio) has disclosed (U. S. 2,398,429) a waterless oil containing a reaction product of phosphorus pentasulfide and a mineral oil, such as one of 100 sec. Saybolt viscosity at 100° F., or poylpropylene. Corrosiveness is eliminated by inclusion of a fatty oil. An oil soluble detergent, such as the dioctyl ester of sodium sulfosuccinic acid, is added to increase wetting of the metal by the cutting oil.

Bottoms from distillation of alkylates are employed by Union Oil Co. of California as bases for **hydraulic fluids and special lubricating oils.** One such sample of bottoms has the following inspection:

Boiling range	450-700° F.
Gravity	39.8° API
Flash C.O.C.	215° F.
Fire	255° F.
Pour point, fluid at	—75° F.
Vis./100° F. S.U.	50.5
Vis./130° F.	41.3
V.I.	0
Vis. gravity constant	0.796
Color (NPA)	1—

This type of product was blended with a V. I. improving polymer, such as polyisobutylene and the blends have been found excellent as hydraulic oils and lubricants at low temperatures (U. S. 2,398,943).

Among the newer **synthetic lubricants**, is an **instrument oil** (U. S. 2,396,191) disclosed by Cities Service, particularly useful for lubricating clocks. Its composition is given as follows:

Dibutyl Phthalate	50% by vol.
Tributyl Phosphate	40% by vol.
Acryloid HF 860	10% by vol.

This blend had a vis./100° F. of 15.4 cs. and 550 cs. at —30° F. Its open cup flash was 340° F. and fire point 365° F. No corrosion was indicated.

Another Cities Service patent (U. S. 2,396,192) discloses a **dental instrument oil** containing mostly a decolorized mineral oil of about 72 S.U.V./100° F., and a minor amount of a mixture of equal parts of octyl and decyl esters of methacrylic acid polymerized to about 15,000 m.w., the final product having a viscosity of about 100 S.U.V. at 100° F.

In its U. S. 2,398,187, Corning Glass Works describes a **hydraulic fluid containing a liquid organosiloxane,** such as liquids resulting from the cohydrolysis

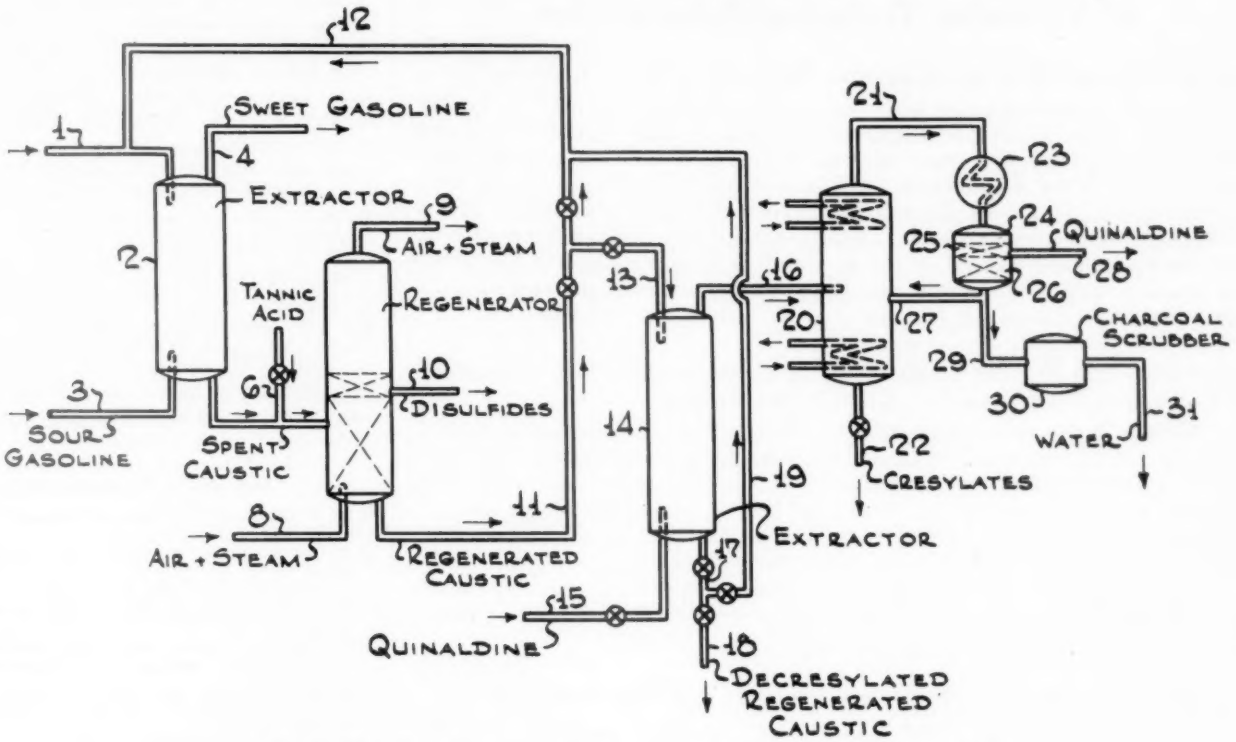

Fig. 2—Flowsheet for process for recovery of cresols from spent caustic

of 90 mole equivalents of $(CH_3)_2Si(OEt)_2$ and 10 mole equivalents of $(CH_3)Si(OEt)_3$. The products possess low freezing points and exceptionally high viscosity indices. A viscosity-temperature chart of high polymeric dimethyl silicone fluids of different intrinsic viscosities is shown in Fig. 1. Practically all of these products possess flatter viscosity temperature curves than high grade hydraulic oils now sold commercially.

Recovery of Cresols from Caustic

Since considerable discussion is now concentrated on cresylic acids with a view toward extending supplies, it would be justified to describe here a process (patent pending) for recovery of sodium cresylates from spent caustic used in sweetening operations. The method, known as the **Berger Process,** owned by a group of individuals, is already in the pilot plant stage and employs coal tar base-type solvents, such as quinaldine, quinoline,, isoquinoline, etc., which have been available as a crude cut selling for about 64c per gallon. The base solvent extracts preferentially the sodium cresylates from the waste caustic.

Referring to a flowsheet of the process shown in Fig. 2, sour gasoline is extracted in Tower 2 with the usual 15-20% caustic soda, thereby removing most of the mercaptans and practically all of the cresols. The spent caustic thus produced is drawn off the bottom of the tower, tannic acid oxidation catalyst is added, and air and steam are blown in to oxidize the sodium mercaptides to disulfides in the conventional manner. The disulfides are drawn off as an oily layer, while the regenerated caustic, still containing sodium cresylates, is drawn off through line 11 and recycled.

If recycling of all of the regenerated caustic is carried out, a point is soon reached when the cresylates have built up to such a concentration as to prevent further extraction of mercaptans by the free caustic still left in the solution. In the conventional operations, the caustic is withdrawn at this point and either discarded or neutralized with sulfuric acid for regeneration of cresols. When this is done, a wastage of 10-15c worth of free caustic per pound of cresols regenerated generally takes place.

In the Berger process, a sidestream, 13, is withdrawn from the recycle regenerated caustic line and this is extracted counter-currently with a solvent such as quinaldine, for example. This

TABLE 1—Effect of Selenium Compounds as Antioxidant Additives

	Oxygen absorbed by base oil plus compound listed						
Time, hrs.	Nil	Dicetyl sulfide	Diphenyl selenide	Cetyl-phenyl selenide	Dibenzyl selenide	Dicetyl selenide	Dilauryl diselenide	Didecyl selenide
0.05	33	....	....	....	....	....	....	....
0.15	....	20	0	....	....	....	....	....
0.20	96	....	....	....	....	....	....	....
0.25	522	....	....	....	....	....	....	....
0.30	1,746	....	458	....	....	....	....	....
0.32	....	....	....	728	....	....	....	....
0.35	....	506	1,048	1,456	....	....	....	....
0.40	....	1,380	....	3,022	....	....	....	....
0.45	....	2,436	....	....	....	....	....	....
0.50	....	....	1,706	....	....	0	....	....
1.00	....	....	....	....	....	0	....	0
1.40	....	....	....	....	630	....	....	....
1.50	....	....	....	....	....	....	0	....
1.55	....	....	....	....	4,012	....	....	....
2.00	....	....	....	....	....	....	....	0
2.50	....	....	....	....	....	....	21	....
2.60	....	....	....	....	....	174	....	....
2.90	....	....	....	....	....	1,450	....	....
3.00	....	....	....	....	....	....	....	44
3.50	....	....	....	....	....	....	40	....
4.00	....	....	....	....	....	....	....	152
4.30	....	....	....	....	....	....	....	571
4.40	....	....	....	....	....	....	....	1,906
4.50	....	....	....	....	....	....	117	....
4.90	....	....	....	....	....	....	207	....
5.10	....	....	....	....	....	....	850	....

GAS ANALYSIS — PROCESS CONTROL — LUBRICANTS

Add these Latest Books to Your Library of Valuable Technical Information

Gas Analysis and Testing of Gaseous Materials (*By V. J. Altieri*)

Newest comprehensive book of standards for sampling, analyzing and testing gases and their mixtures . . . Brings under one cover all the published technical literature on this subject as well as the personal experiences of men in the field . . . Gives details of safety and accident prevention . . . Contains 20 well illustrated chapters, also tables and a bibliography. Includes name and subject indexes and an appendix of valuable technical material, much of which is in tabular or graphic form and pertains to physical constants data, properties of gases and various correction and conversion factors . . . 567 pages . . . $7.50

Instruments and Process Control (*By R. E. Clarridge, J. S. Detwiler, G. E. Heller, R. N. Pond and B. C. Delahooke*)

Written in layman's language, this monograph was prepared in the Curriculum Laboratory at Cornell University in cooperation with the Taylor Instrument Co. . . . Explains industrial processes and the measurement and control of its variables . . . Defines common instrument terminology . . . Discusses basic control theory, simple controllers, controller mechanisms, and the application of controllers . . . Contains over 200 illustrations, photos and drawings . . . Well prepared and easy to read . . . Typewritten reproductions, 233 pages, 8½ x 11, paper cover and plastic bound . . . $2.75

A. S. T. M. Standards on Petroleum Products and Lubricants (1945)

Contains 80 standard and 5 emergency standard methods of test; 11 standard and 2 emergency specifications and 3 standard definitions. Covers gasoline, fuel oils, Stoddard solvent, cut-back and emulsified asphalt (several grades of each) mineral spirits and thermometers . . . Appendices show the results of tests on the development of a method for estimating maximum pour points of lubricating oils containing pour point depressants . . . and the proposed method of test for such pour points . . . also the proposed method of test for total olefinic and aromatic hydrocarbons in gasoline . . . 546 pages . . . $2.75

Lubricants and Cutting Oils for Machine Tools (*By W. G. Forbes*)

Covers the fundamentals of lubrication and the application of numerous types of cutting oils in relation to machine tool operations . . . Discusses the various properties of lubricating and machine oils, their relative importance, and methods of testing, as well as their composition, compounds and blends . . . Suggests points to be covered when specifying lubricating and cutting oils . . . Deals with lubricating greases. Gives practical applications of cutting oils . . . Prescribes treatment and offers suggestions for the prevention of skin diseases resulting from contact with lubricants . . . 90 pages, $1.50

Lubrication of Industrial and Marine Machinery (*By W. G. Forbes*)

Discusses principles of lubrication for common types of engines and machines; with descriptions, explanations and analyzations of everyday lubrication problems. Covers mechanics of lubrication, fundamentals of production, tests and specifications for lubricating oils, and methods of applying lubricants . . . 314 pages, $3.50

Lubricating Oil Additives (*By G. G. Pritzker*)

Three articles from NPN's TECHNICAL SECTION reprinted in one booklet . . . Reviews the patent literature on the use of sulfur and sulfur compounds as addition agents. The first article discusses sulfonic derivatives as lubricating additives; the second, sulfur and sulfur chloride organic reaction products; the third, phosphorus sulfide organic reaction products . . . 24 pages, 25c

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removes most of the sodium cresylates, so that substantially pure caustic solution may be drawn off the bottom at 18 and recycled to the sweetening operation. The cresylate-containing quinaldine is then distilled in Tower 20, which removes quinaldine and some water overhead while the cresylate remains in the tower. Water from the condensate may be returned to Tower 20 to keep the cresylates in a fluid condition.

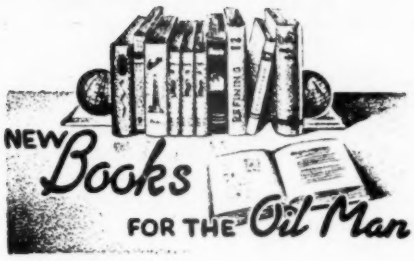
Good solvent recovery is claimed for the process. Other advantages are; more efficient extraction of mercaptans (by control of recycle cresylate concentration) resulting in better lead susceptibility of gasoline and, of course, recovery of free caustic (otherwise discarded) and relatively pure cresols.

Selected Patents

U. S. 2,398,973 (United Gas Improvement Co.)—Isoprene purification.
U. S. 2,399,050 (Std. Oil Dev. Co.)—Catalytic apparatus.
U. S. 2,399,093 (Gulf)—Isomerization.
U. S. 2,399,662 (S. O. Ohio)—Alkylating aromatics.
U. S. 2,399,672 (Jasco)—Isoolefinic polymers.
U. S. 2,399,678 (Houdry)—Dehydrogenating catalysts.
U. S. 2,399,716 (S. O. Indiana)—Polycyclic aromatic alcohol.
U. S. 2,399,723 (Kellogg)—Gas hydration.
U. S. 2,399,741 (Universal Oil Prods.)—Conversion of dicyclic dihydroterpenes to cyclopentene and pentamethylene hydrocarbons.
U. S. 2,399,751 (Universal Oil Prods.)—Aromatization.
U. S. 2,399,765 (S. O. Indiana)—Isomerizing light naphtha paraffins.
U. S. 2,399,780-1 (Texas)—Toluene by benzene exchange.
U. S. 2,399,805 (Shell)—Increasing aromatic content of straight run naphthas.
U. S. 2,399,817 (Socony)—Oil containing diolefincarbonyl compound copolymer as viscosity characteristic improver.
U. S. 2,399,827 (Phillips Petroleum)—Catalyst chamber.
U. S. 2,399,837 (Phillips Petroleum)—Recovering diolefins.
U. S. 2,399,873 (Stanco)—Coating cellulosic material with preservative.
U. S. 2,399,878 (Std. Oil Dev. Co.)—Metal derivatives of alkyl phenols.
U. S. 2,399,882 (Std. Oil Dev. Co.)—Olefin concentration.
U. S. 2,399,883 (Std. Oil Dev. Co.)—Isomerization.
U. S. 2,399,895 (Std. Oil Dev. Co.)—Dehydrogenation and isomerization.
U. S. 2,399,927 (Anglo-Iranian)—Isoparaffins.
U. S. 2,399,976 (Shell)—Isophorone.
U. S. 2,400,020 (Std. Oil Dev. Co.)—Cracking oils.
U. S. 2,400,025 (Std. Oil Dev. Co.)—Catalyst.
U. S. 2,400,041 (Shell)—Hydroxymethyl tert. butyl peroxide.

CORRECTION

It was stated in the April 3, 1946, issue ("Patent Trends in Petroleum Refining," page R-251) that U. S. patents 2,395,379 and 2,395,380 were owned by the Sinclair Refining Co. That was in error. The patents, 2,395,379 for benzaldehyde as a lubricant and 2,395,380 for an ester mixture used as a synthetic lubricant, belong to the Cities Service Oil Co.



Copies of all books reviewed on this page can be ordered from the Book Department of *National Petroleum News*, 1213 West Third St., Cleveland 13, for the prices listed, postpaid, unless indicated otherwise. Ohio purchasers please add 3% tax.

Fluid Measurement Is Subject Of New Engineering Handbook

Flow Meter Engineering Handbook, by Louis Gess and R. D. Irwin, 8 x 10½ in., 151 pages, stiff cloth binding, illustrated, $2.50.

A complete yet concise treatment of fluid measurement, including related equipment, equations and computations in terms of steam, water, oil and gas flow, is included in the second edition of the *Flow Meter Engineering Handbook*.

Compiled and edited by Louis Gess and R. D. Irwin, in the flow meter engineering department of Brown Instrument Co., a division of Minneapolis-Honeywell Regulator Co., the new volume "has been written to expand the original information and to include suggestions made by users of the first edition to improve its usefulness."

The first chapter discusses principles of orifice meter measurement, followed by succeeding chapters on the orifice plate and differential connections, design details, flow approximation tables, derivations of working formula, working equations, compressibility of gases. relationship between coefficient of discharge and Reynolds' number, viscosity of fluids, and orifice calculations for steam, water, oil and gas flow.

The final chapters are given over to a summary of equations and nomenclature, corrections for changes in operating conditions, and volume computations. Thirty-eight figures and 55 tables are included.

The book is published by the Brown Instrument Co., and quite naturally, of course, contains considerable data and illustrations of Brown's own instruments. Despite that fact, *Flow Meter Engineering Handbook* is replete with much valuable information for refinery engineers who have anything to do with fluid measurement and control.

Lubricants Research Included In 1946 CRC Handbook

CRC Handbook, by the Coordinating Research Council, Inc. Includes 44 authorized CRC test procedures; 81 figures of charts, test procedure data forms and illustrations of test apparatus, $7.00.

NOTE—Distribution partially restricted. Send orders to Coordinating Research Council, Inc., 30 Rockefeller Plaza, New York.

Since the new edition contains an entirely new section, on Lubricants Research, it has been given the title *CRC Handbook*, instead of CFR (Coordinating Fuel Research), as were the previous editions, which dealt only with fuel research.

The book presents the latest revised editions of CRC test procedures, and information bearing on the development, use and subject matter of these procedures. The Fuel Research section covers motor fuels, aviation fuels and Diesel fuels. The Lubricants Research section includes engine oils and general lubricants.

In Appendix I a summary is given of materiel—publications, test apparatus, reference and test fuels and lubricants—made available by or through CRC for use in its test procedures or research programs, and directions are given for obtaining such materiel. The bibliographies of Appendix II are classified according to subject matter, and are complete lists of all authorized reports on CFR and CRC research appearing in the publications of the two sustaining members, the American Petroleum Institute and the Society of Automotive Engineers, together with other pertinent articles.

New Encyclopedia Gives Data On C_1—C_5 Hydrocarbons

Encyclopedia of Hydrocarbon Compounds, Vol. I, C_1—C_5, compiled by Joseph E. Faraday, 5½ x 8½ in., approx. 400 pages, loose-leaf binding in stiff cloth cover, $15.00.

In the literature of Organic Chemistry there are two comprehensive works that detail every compound known, identified and analysed up to a certain date. These are "Richter's Lexicon der Kohlenstoff Verbindungen" and "Beilstein's Handbuch der Organischen Chemie." They suffer from the great disadvantage that they are decades out-of-date, from the minor drawback that they are in German, and in the case of Beilstein from a very complicated system of arrangement.

The *Encyclopedia of Hydrocarbon Compounds* was prepared with the idea in mind of overcoming these disadvantages. It appears to be originally a British publication, and is reported to be complete up to Jan. 1, 1944, with some wartime-caused exceptions. It is published in loose-leaf form so that it can be kept up-to-date by the issuance of regular yearly supplement sheets.

Vol. I deals with hydrocarbons containing one to five carbon atoms, arranged according to the formula index system of Richter. For each of them, where the details are available, the following information is presented: molecular and structural formulas, names of the compound, occurrence in nature, all known methods of preparation with complete bibliography, physical constants, methods of detection and determination, outstanding properties and reactions.

Sources of information for the data presented are Beilstein's Handbook and its supplements, together with the three major abstract journals of chemistry—"Chemical Abstracts," "British Chemical Abstracts" and "Chemisches Zentralblatt."

Although a little cumbersome to handle in its loose-leaf form (the book was assembled apparently for durability, is printed on rather heavy paper, has a thick binding), the *Encyclopedia of Hydrocarbon Compounds* should prove a valuable time-saver in literature searches involving the C_1—C_5 group.

New C.N.G.A. Bulletin Replaces 1939 Edition

Tentative Specifications and Tentative Standard Methods of Test for Liquefied Petroleum Gases, Bulletin TS-441, compiled by California Natural Gasoline Assn., 9 x 11½ in., 70 pages, paper binding, indexed and illustrated. $1.00 to CNGA members. $1.50 to others.

The latest specifications and methods of test for liquefied petroleum hydrocarbons has been compiled by California Natural Gasoline Assn. in Bulletin TS-441, to replace its former Bulletin TS-392 published in 1939. It defines and describes the composition of liquefied petroleum gases, classifies them into grades, and presents tentative standard methods for identifying, grading and handling them. It is intended for manufacturers, marketers and consumers who have occasion to gauge, blend, sample, specify or test LPG products.

An entirely new set of tables of volume correction factors for converting observed volumes to volumes at 60° F. is included, based on the latest available information concerning the variation of volumes with temperature. A new section has been added on the computation of vapor presures and a chart of "corrected vapor pressures" has been included which permits more accurate prediction of the vapor pressure of LPG products than hitherto has been possible. A formula is given for use in blending LPG stocks to produce a mixture of specified vapor pressure. Methods are given also for securing representative samples of LPG from pipelines or storage vessels.

Several new or improved methods of testing LPG are presented. These include improved methods for determining vapor pressures and specific gravities, and a new simple and fast method for determining propane, isobutane, normal butane and isopentane in LPG. In addition, the bul-

letin gives specifications for the six standard C.N.G.A. grades of LPG.

Miscellaneous charts, tables and illustrations are presented, including tables for correcting observed specific gravities to gravities at 60° F./60° F. A table of physical constants of light hydrocarbons and a vapor pressure correction for LPG is also contained in the bulletin.

The work is divided into four parts: specifications, tentative standard methods of test (vapor pressure, specific gravity, weathering test analysis, isobutane in propane and water content), correction factors for use in gauging shipments, and four appendixes.

Guide for Training Plant Fire Fighters

Industrial Fire Brigades Training Manual, published by the National Fire Protection Assn., 6 x 9 in., 188 pages, stiff paper cover, illustrated. Single copies $1.50; single shipments of 15 or more copies $1 per copy.

This manual was prepared by the N.F.P.A. Committee on Firemen's Training, a group of fire service officials and fire protection experts, to aid in the planning needed to produce a competent fire-fighting organization. While intended primarily as a training manual for classes assigned to work under the direction of the plant brigade chief, it will also prove valuable in smaller plants requiring the essentials but not the details of a large plant setup. It also meets the need for a reference book where a plant brigade is already organized.

The text is general in nature and does not cover training to fight petroleum or any special type of plant fires. Topics include organizing the plant fire brigade, necessary routine for the maintenance of plant fire protection, and general information on fire hazards. It includes instructions in making forcible entry, using minor fire fighting appliances, handling rope, hose and ladders, producing effective fire streams, ventilating, salvaging, caring for fire brigade equipment, and making periodic inspection of fire protection equipment.

Describes Catalytic Principles And Applications in Processing

Catalytic Chemistry, by Henry William Lohse; 8½ x 6 in., 471 pages, stiff cloth binding, indexed and illustrated, $8.50.

One of the latest additions to the literature on the subject is *Catalytic Chemistry* by Dr. H. W. Lohse, consulting chemist and spectroscopist. In writing this book, the author has aimed at a brief factual presentation of the underlying principles of catalytic phenomena and the application of catalytic reactions in industrial processing.

It will be noted that considerable stress is laid on the subject of minor constituents or impurities which may be present in the catalytic materials. The author states "I do not honestly feel that, up to this time, enough attention has been paid to the presence of impurities in catalytic reaction systems nor has complete enough account been given of the various substances present in the reaction systems during the reaction, to warrant sweeping statements even when based on a very large number of reports on catalytic research. Furthermore, it must be kept in mind that catalytic reactions are extremely varied, and the data obtained in catalytic works are very often influenced by the history of the case at hand."

The book begins with a brief history of catalytic chemistry, following this with an extensive chapter requiring more than 100 pages for presentation on the subject of "Catalytic Theory." Next in logical order comes chapters on the nature and properties of catalysts and specific types of catalytic reactions. The last chapter will be one of particular interest to the oil industry, that on "Industrial Catalytic Reactions." Covered in this section are products from carbon oxides and water gas, natural gas, production of alcohols, production of motor fuels, synthetic rubber, and hydrogenation of fatty acids and oils for production of higher alcohols and esters.

Throughout the book will be found extensive tables, chemical equations and, where necessary, flow diagrams. Each individual section of the book is complete with the appropriate citations to literature; there is also an author index and an extensive subject index.

Lecture Series on Chemistry Of High Polymers Published

Advancing Fronts in Chemistry, Volume I, "High Polymers", edited by Sumner B. Twiss, 6 x 9 in. 196 pages, stiff cloth binding, indexed and illustrated, $4.00.

Advancing Fronts in Chemistry, Volume I on "High Polymers" presents a series of ten lectures sponsored by Wayne University under the direction of Neil E. Gordon, Chairman, Department of Chemistry. Because of their wide scope and the universal interest they arouse, the lectures are being presented in their entirity to a larger audience through publication.

They represent a logical, if limited, development of the recent chemistry of high polymers, which will be of interest to the beginner as well as the trained investigator.

The first three chapters, "Molecular Structure and Mechanical Behavior of High Polymers," "The Relation Between Structure and Physical Properties of High Polymers" and "Some Applications of Catalysis to Hydrocarbon Reactions of Importance in the Synthesis of High Polymers," present rather elementary material and are included because, for many, this may be the starting point in the study of high polymers. These first chapters give a sound foundation to the trained chemist for adequate digestion of the material in the later section.

Chapters 4 and 5, considered as a unit, give a review of the direct and indirect evidence for the free radical mechanism of addition polymerization. Chapters 6 and 7 are similarly related, and present a discussion of the importance of chain links and size distribution.

One of the most important phases of high polymer chemistry is the study of the geometry of long-chain molecules and the effect of inter-molecular forces as illuminated by X-ray diffraction studies. This subject is presented in detail in Chapter 8.

A new and different approach to the problem of orientation of chain polymers and their mobility in the liquid state is through the study of the mechanical properties of their concentrated solutions. The recent work with this technique is given in Chapter 9.

Perhaps most fitting as the concluding chapter of this book is the presentation of the ultimately practical work which has been accomplished with the natural polymers—silk, cotton and wool.

At the beginning of each chapter are a photograph and brief biographical sketch of the author's life. Bibliographies are presented at the end of each chapter; there are no footnotes used.

Presents Electron Microscope For Non-technical Reader

The Electron Microscope, by E. F. Burton and W. H. Kohl, 6 x 9-in., 325 pages, stiff cloth binding, indexed and extensively illustrated, $4.00.

This book, *The Electron Microscope*,, "An Introduction to its Fundamental Principles and Applications," is written specifically for the non-technical reader interested in modern techniques. The authors are E. F. Burton, Head of the Department of Physics and Director of the McLennan Laboratory, University of Toronto, and W. H. Kohl, formerly chief engineer, Rogers Electronic Tubes Limited, Toronto.

It aims at presenting the physical principles on which the operation of the electron microscope is based without assumptions in regard to the technical knowledge of the reader. The subject matter is such, however, that a large amount of ground must be covered and many intricate problems solved. This requires more than a superficial interest, a great deal of patience and preseverance on the part the reader, who in turn may gain much useful knowledge which applies to general physics and electronics.

In this, the second edition, the text

has been rearranged and revised in many places to attain greater coherence of the subject matter. Some material has been eliminated as being of too specialized a character for the scope of the book. The chapter on the history of the electron microscope has been eliminated and part of its contents incorporated in other chapters. The chapters on electron optics have been enlarged and the material on electron lenses consolidated with them. The chapter on the compound magnetic electron microscope has been re-written and much new material added. The chapter on the applications of the electron microscope has also been largely re-written and the plate illustrations of the accomplishments of the electron microscope are collected there.

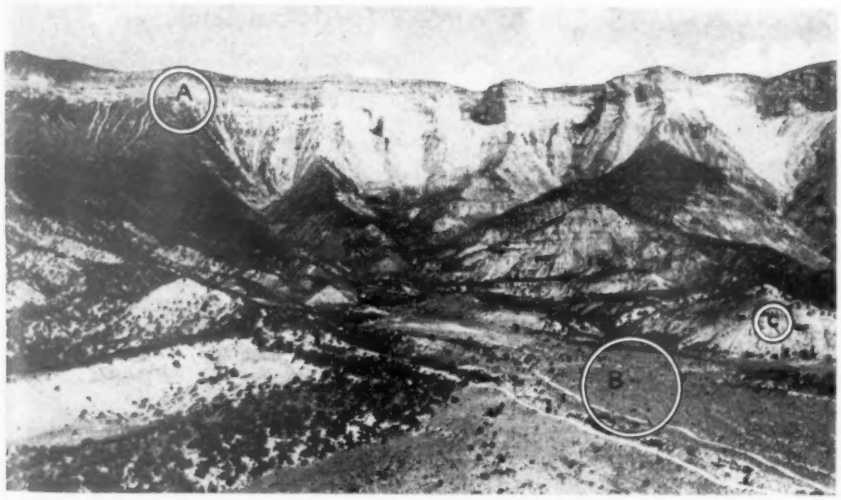
This book is a well written exposition of elementary optics as well as electronics. Many of the phenomena discussed will be readily recognized by the reader as applicable to many other types of optical and electronics devices and should lead to a much clearer understanding of them all. For those who are interested in a layman's description of the instrument and allied devices, this book will provide very interesting reading. For the browser, an informative hour can be profitably spent in simply looking at the illustrations which depict the world of the minute, about which all of us have more or less a curiosity. An extensive bibliography of electron microscopy, covering 18 pages, in addition to a name and subject index, completes the book.

Helpful Trade Literature

Hydrocarbon Thermodynamics, by Wayne C. Edmister: Forty pages of text, 23 charts and diagrams, and literature references, describing the applications of thermodynamics to heat balances, phase equilibria and chemical reactions for hydrocarbon systems. The technique for applying the charts is given. A plan or pattern for developing and applying thermodynamic process design tools to hydrocarbon processing is presented. Originally given as a paper before the California Natural Gasoline Assn., this data has been prepared in pamphlet form by Petroleum Refinery Division, Foster Wheeler Corp., 165 Broadway, New York.

A.S.T.M. Supplement: The 1945 supplements to the 1944 (latest) Book of A.S.T.M. Standards are now available, in three parts, giving specification, tests and definitions which were either issued for the first time in 1945 or have been revised since their appearance in the 1944 book. Part III of the supplements, Nonmetallic Materials (General), 500 pages, includes 10 specifications and tests for petroleum products and lubricants. Copies of the supplements may be obtained from A.S.T.M. headquarters, 1916 Race St., Philadelphia, at $4 for each part.

Bureau of Mines Experimental Oil Shale Mine Project Under Construction in Colorado



Aerial view of the near Rifle, Colo., where the Bureau of Mines will have its demonstration plant for extracting oil from shale. Shale will be mined from the cliff in the background at "A", and will be transported by truck to the demonstration plant, being erected in the area behind the hill "C" at the right. A camp to house the plant and mine personnel is being set up in the area "B", and will include 50 housing units. Utilities not being available in the area selected, the Bureau had to install a power transmission system ($61,700), and 7220 ft. of 6-in. pipe to bring water from the Colorado river

TECHNICAL MEETINGS FOR OIL MEN

June

2-7, Society of Automotive Engineers, semi-annual meeting, French Lick Springs Hotel, French Lick, Ind.

20-23, Society for the Promotion of Engineering Education, 53rd annual meeting, Jefferson Hotel, St. Louis.

24-28, American Society for Testing Materials, annual meeting, Statler Hotel, Buffalo, N. Y.

August

25-28, American Institute of Chemical Engineers, western convention, Palace Hotel, San Francisco.

September

9-13, American Chemical Society, 110th meeting, Chicago.

10-14, 4th National Chemical Exposition, Coliseum, Chicago.

16-20, National Instrument Conference, sponsored by Instrument Society of America, Wm. Penn Hotel, Pittsburgh.

18-20, National Petroleum Association, 44th annual meeting, Hotel Traymore, Atlantic City, N. J.

October

7-12, American Gas Association, annual meeting, Atlantic City, N. J.

November

7-8, Society of Automotive Engineers, National Fuels and Lubricants meeting, Mayo Hotel, Tulsa.

11-14, American Petroleum Institute, annual meeting, Stevens Hotel, Chicago.

December

2-6, American Society of Mechanical Engineers, NYC.

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WIDENING HORIZONS

Views on Personnel, Management and Economic as Well as Technological Developments in Petroleum Refining and Natural Gas Processing: Comment from Readers is Invited

Oil Companies Can Help Their Research Staffs to Find Their Voice

Considerable talk is heard today on the aloofness of technical industrial research workers from the affairs of the ordinary business world, and their inability to express themselves in the language of the man on the street.

The public, made conscious during the war of the great scientific achievements of the present years, wants to know more of what is taking place in the research workshops where these amazing new developments are being created. The scientist who has demonstrated that the forces he creates may have much to do with the future of our world is expected to join with the economist and statesman in discussing these matters. Too often he is inarticulate on both counts.

Highlighting comment of this kind is an article in the March *Harper's Magazine* by an author in the university press publishing field. His title is, "I Can't Quite Hear You, Doctor". Here is a brief quotation from it.

"No public relations council has explained to the rest of us the ultimate meaning of their discoveries. The scientists have maintained their own societies, published their own magazines; they have a world apart, regally oblivious to the feudal society below. . . .

". . . The truth is that, in the period of the most widespread education in the history of mankind, we have established a twentieth-century feudalism. The difference between it and medieval feudalism is that it is intellectual rather than economic. In the period of medieval feudalism the gulf between the lord of the manor and the villian or the serf tied to the land was both intellectual and economic; but the principal characteristic of that gulf was economic. It is true, of course, that the serf had intellectual freedom. But it is equally true today that the average citizen cannot speak intelligently about, or criticize constructively the scientific age. The gulf between them and those who understand is too great."

It is much to be doubted if the blame in this matter lies entirely with the scientist. In our own petroleum industry the attitude of the oil companies toward their research staffs has been such as to induce them to consider themselves and their work entirely apart from other oil company activities. The new and improved products originating in research are publicly announced through the sales and advertising departments. Very seldom are made known the names of the men who created the improvement and developed it experimentally. How many oil companies have made their research director a member of the board of directors, or given him other public recognition for his important part in the company's affairs?

Indicative of the oil companies' general attitude is the fact that the discoveries of their research departments frequently do find first publicity in the form of highly technical papers presented to an audience exclusively of scientists.

These discoveries are the results of extensive and costly research financed by the oil company, sometimes extending over years. Often they are of importance to the oil industry in pointing out new technological trends. So it would seem that they should be brought to the general attention of the industry, if for no other reason than as a matter of company pride.

Oil company management should encourage and aid their technical staffs in telling the general story of what is being done in their research workshops. This phase of an oil company's activities is as important as a new service station design or a new sales program and there is no reason for the high degree of secrecy maintained concerning most of this work, which is the current practice. The story can best come from the research men themselves. They could talk before clubs and schools, where their stories would reach students, some of whom will be later enlisting in scientific industrial research work, and might become interested in the petroleum field.

Again, the first public announcements of new products offered by the oil companies could be signed by the scientists who had developed them through the experimental stage. This might add to the public's acceptance of new products. Technical sales literature could be signed by the men who had developed the product and would have to stand behind it.

A policy on the part of the oil companies in bringing public attention to their research staffs and their work would help keep alive this topic of industrial research in the petroleum field. It would serve to counterbalance, to some extent, the great amount of talking by the Bureau of Mines, the Army and the Navy of their own research plans. Unless the oil companies talk of their own work the public might easily assume that only the government agencies are active in petroleum research.

Salute to a New Technical Society

Until the National Association of Corrosion Engineers was formed by a handful of men in 1943, there was no organization cutting across all industry lines which was devoted exclusively to the new and rapidly developing branch of engineering dealing with corrosion. Indicative of the support this society is receiving, membership has jumped from less than 50 when it was started to over 700 as of May 9, 1946, when this young technical society concluded its first full convention. Many of its members are from the oil companies and allied equipment manufacturing firms.

Most causes of corrosion and many of the mitigation methods are fundamentally the same in all branches of industry. What works in the protection of underground electric cable sheaths, for example, may be applicable to the oil industry's pipelines. A method of treating cooling water at a chemical plant may serve equally well at a generating station, refrigerating plant or petroleum refinery.

The Association of Corrosion Engineers has a big job on its hands, for corrosion is one of the greatest thieves of industry's time and money and is not at all particular where it strikes. The society can perform an important function in providing a common meeting ground for all technical men working on this subject, and a medium for the comprehensive interchange of new information developed on protective methods.

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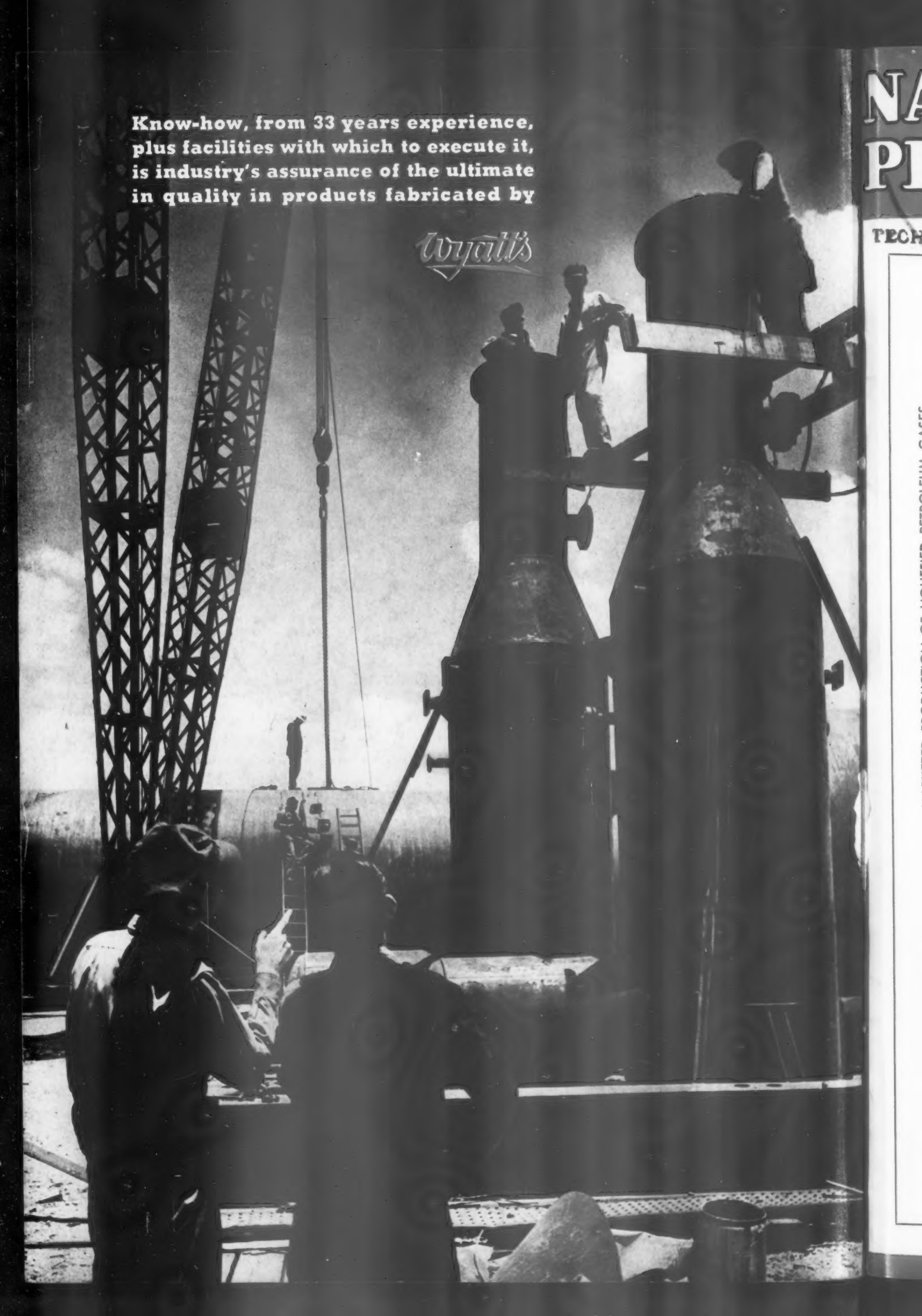
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